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TABLE OF CONTENTS.

Engineering News of the Week 241, 242

Technical and Illustrated Articles:

The Economical Disposal of Ashes and Other City Refuse 242
Railways in Asiatic Turkey 246
Railways and Public Works in China 248
Two Flat Runs 243
The Hall Electric Pump 244
Notes on European Reservoir Dams 244
A Novel Plan for the World's Fair Building 245
Forth Bridge "Specials" 245
Steel Water Pipe 246
Foreign Road Construction and Maintenance (*continued*) 246
English Engineering Societies 246
The Georgia Southern & Florida Railroad 248
The Alabama Midland Railroad 248
The Normal Monthly Rainfall of the United States 248
Car Heating in Germany 249
The Winner Bridge at Kansas City, Mo. (*with Inset*) 249
Covered Reservoir, Hudson, Wis., Water-Works 249
Refinements of Modern Measurements 250
Gradient Indicator for Drains 250
One of the Dangers in Excavating Sand 250
The 458-ft. Chimney at Halsbrucke, Saxony 250
Tests of the Transverse Strength of Aluminum 250
Shield for Hudson River Tunnel 257
Professional Water Finding 257
German Experience with Tie Plates 258
A Complicated Crossing Plan 259
The Paving Problem 259
The Weather for February 259

Personals, Publications Received, Trade Publications, Society Proceedings 251

Editorials and Editorial Notes 252

A Correction—Curved vs. Straight Dams—English and American Express Engines—Direct vs. Indirect Steam-Heating for Cars.
An Inexcusable Accident 253
President Blackstone's Plan for Government Railway Ownership 254

Correspondence 255–257

The "New Era" Grinder—Mexican Practice in Vertical Curves—The Rockcliffe, Ont., Collision—The Deflection Test on Old Bridges—The Properties of Aluminum—A Correction of North River Bridge Reports—Notes and Queries.

Railways, Rapid Transit, Highways, Water-Works, Bridges, Tunnels and Canals, Electrical, Sewerage and Municipal, Contracting, Proposals Open, Manufacturing and Technical 259–264

ENGINEERING NEWS.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS has arranged to purchase for $70,000 or thereabouts, we understand, the commodious building at No. 12 West 31st St., now belonging to a medical association, the larger part of the purchase money remaining on mortgage, and $30,000 being raised by 20-year 5 per cent. second mortgage bonds, one-twentieth of the bonds being retired annually by lot. They have organized a "Library Association" and also arranged with the Institute of Electrical Engineers to occupy the same building with a joint library. In the meantime the effort to put some life and health in the American Society of Civil Engineers by a revised form of organization seems to be advancing with unfortunate slowness.

THE GILROY PAVING PLANS for New York include the execution of the following work: Granite blocks on concrete foundation, 102,000 sq. yds., estimated cost, $459,000; 67,230 sq. yds. of asphalt on concrete foundations, $301,170; 49,280 sq. yds. asphalt on present stone blocks, $197,120. Total area, 218,510 sq. yds.; total estimated cost, $957,290. Mr. GILROY calls renewed attention to the absolute necessity of legislative enactment, regulating street breaking, before this important paving work is commenced. At present he has insufficient authority over private corporations, and in many cases he "finds it impossible to carry out his views and intentions as to the improvement and maintainance of pavements."

THE HENNING EAST RIVER TUNNEL is let for construction to the American Tunnel Construction Co., organized under the laws of West Virginia with a capital of $300,000, with authority to increase this to $2,000,000. Col. R. R. HUNT, of Kansas City, is the President. By the terms of the contract surveys and borings are to be commenced within 60 days, and steps be taken to secure the assent of the authorities of New York and Brooklyn. The company claims it can finish the tunnel within two years after this authority is secured. This is the Henning gravity scheme, or "toboggan road," already described in this journal.

THE COMPLETION OF THE CHICAGO LAKE TUNNEL is promised by Contractor ONDERDONK by June, 1891, which will be within his contract time. A committee of Chicago aldermen lately visited the tunnel. They found the tunnel out 4,200 ft., and progressing at the rate of 15 ft. per day, in the two 6-ft. tunnels, from each face. The intermediate shaft, 2½ miles out, is practically finished, and it is expected that in a few days work will be pushed both ways from that shaft. The 4¼-mile crib is being "rushed," and "will soon be in place," so that work can be commenced inward from that point also. The material now being excavated is hard-pan, and Mr. ONDERDONK hopes he has passed the quicksand troubles.

A VERY HEAVY flat car has been built at the Fitchburg Railroad car shops in East Fitchburg, Mass. It is a special car built to carry a large wire cable weighing 60,000 lbs. from Worcester to a mine near Denver, Col. The car is 28 ft. long, 8 ft. 8¾ ins. wide, has eight sills running lengthways, each 4¾ × 11 ins., end sills 9 × 9 ins. The floor of the car is covered with 2-in. oak plank. It has two six-wheeled trucks; the trucks, with their fittings, weigh about twice as much as those on a common car. The axles are 5½ ins. in diameter, the bearings 4½ × 8 ins.; the beds, two to each truck, are made of oak timbers bolted together, with two ¾-in. flat irons between, making a solid bed 9 × 13 ins. square. The centre bolt is 2 ins. in diameter. There are four iron trusses on each bed that have each a capacity of holding 24 tons. The car is supported underneath by four heavy bolsters, strongly bolted to the sills with flat irons, ¾ × 5 ins. The centre bearing, which rests on the centre bed, is 4½ × 14 ins., and is supported by two heavy iron trusses made of ⅞ × 5 in. flat iron. The car is equipped with the Westinghouse air brake, and the common hand wheel brake. The drawbar is of Safford's patent, works automatically, is made of malleable iron, and is easily worked. The car is built of the best material, in a thorough manner, and will be rated to carry 100,000 lbs.

THE TUBULAR FRAME CAR CO. was lately represented by its English agent, Mr. M. R. JEFFERDS, C. E., before the Parliamentary Commission of the Board of Trade Inquiry on railway rates. Mr. JEFFERDS stated that in spite of double prices for fuel and labor in America, it cost three times more to move freight in England than in the United States. This fact he attributed entirely to the ancient type of English rolling stock. The statement that he had sold American cars built in New York to English railway companies was unpalatable to the Commission, and it was especially disgruntled at the further statement that he could deliver these American built cars at less cost than they could be made in England.

As an addendum to this experience, it might also be said that Mr. W. PULLMAN has made a proposition to supply the railway commissioners of New South Wales with his cars. *The Colonies and India*, of London, says: "It is likely, however, that some of these cars will be run as an experiment on the southern line, before an extensive order for the cars is given."

SUSPENDED FOUNDATIONS FOR ENGINES.—An interesting feature of the plant at the Spreckels sugar refinery, Philadelphia, is the hanging foundations for steam engines. The engines used in this establishment are distributed practically all over the buildings, a large proportion of them being on upper floors. Some of these engines are bolted to iron beams or girders on second and third stories of the building, and have consequently no foundation. Some of these engines ran noiselessly and satisfactorily, while others produced more or less vibration and rattle. To correct the latter, the engineers suspended foundations from the bottoms of the engines, so that, in looking at them from the lower floors, they were literally hanging in the air. The foundation does service to an engine, or any machinery by its weight and by absorbing the vibrations.

THE MOST SERIOUS RAILWAY ACCIDENT which has occurred for several weeks was the one on the Lake Shore & Michigan Southern Railway, March 6, between Hamburg and Bay View, N. Y., briefly noted last week. The train was one of the slower expresses from Chicago to New York, its schedule rate being only 32 miles per hour. It consisted of an engine and tender, express car, 2 baggage cars, smoker, 2 day cars, 4 sleepers and a dining car. In pulling out of Dunkirk, N. Y., the coupling between the rear day car and the first sleeper (near the middle of the train) broke; the safety chains also were broken and an air brake hose coupling torn off instead of parting in the usual way. Instead of removing the car or replacing the hose, the train was coupled with a link, and left without brake power on the last five cars (four heavy Wagner sleepers and a dining car). When the coupling again parted, while the train was running at considerable speed on a down grade of 16 ft. per mile, 3½ miles long, the forward section ran ahead, the break-away not being discovered for a time. On discovery, the conductor carelessly signaled the engineer to stop, and collision soon resulted. The sleeping car conductor tried to apply the air brakes by pulling the emergency cord in the first, last and third sleepers, but of course failed, the train having started out with the air brakes on half the train only—the only conditions under which the air brakes could have failed to go on automatically. He was trying to apply the hand brakes when the collision occurred. The first sleeper telescoped the rear day car almost completely. The total number of casualties was 6 persons killed and 15 or 16 injured, about equally divided between the two cars. The wreck of the sleeper started to catch fire from two oil lamps, but the porter extinguished the flames. The nature and causes of the accident are more fully discussed on another page. It is one for which there seems to be little excuse from any point of view.

A SERIOUS ACCIDENT occurred recently on the Oregon Ry. & Navigation Co.'s line near Minnedoka, Idaho. A culvert which had been weakened by floods, gave way under a passenger train. Six cars were derailed and badly wrecked, and several persons were more or less injured.——The Georgia Pacific R. R. has had two derailments. At a railway crossing at Anstelle, Ga., the engine and two cars of a passenger train left the track, but nobody was injured. A car of a gravel train was derailed on a curve and overturned, burying three trainmen under the gravel and severely injuring them.——On March 5 a Pullman sleeping car on a Chicago, Milwaukee & St. Paul train caught fire while the train was near Winona, Minn. The car was badly damaged before the fire was extinguished.——The engine and some cars of a passenger train on the Cleveland, Loraine & Wheeling were derailed March 10 on a bridge near Maynard, O. None of the cars fell off the bridge.

BRIDGE ACCIDENTS are reported as follows: A highway bridge over Bledsoe Creek, near Gallatin, Tenn., was carried away by the flood, March 3. It had three spans of 60 ft.——Three spans and two piers of the Shoal Creek bridge, near Huntsville, Ala., have been washed away.——A wooden trestle on the Louisville & Nashville R. R., over the Manasker Creek, near Edgfield Junction, Tenn., was carried away by the flood on March 10.

THE ELIZABETH, N. J., GRADE CROSSING, the worst on the New York Division of the Pennsylvania R. R. Co., may be soon abolished. The Penna. Co. is willing to elevate its track 18 ft. at the Union depot, leaving the Central R. R. of New Jersey to pass beneath on the present grade. But the latter road would have to elevate its track between Elizabeth and Elizabethport. A conference has already been held between the railroad and city authorities, and another meeting is to be held to arrange details.

THE PRESENT HIGH-WATER IN THE MISSISSIPPI is the most destructive and the highest since the flood of 1874. Since that date the floods of 1878 and 1879 have been the only floods of importance. Since 1865 the States of Louisiana, Mississippi and Arkansas and the United States Government have expended $27,657,488 on levees, and the long period of exemption from flood damage was supposed to be due to this protective work. The flooding of the Tensas Basin by the break in the levee at Arkansas City on March 9, threatens much damage, and has a discouraging effect on the levee builders. The water at New Orleans, on March 7, was the highest ever known.

A SYSTEM OF MOVABLE DAMS for the Ohio River is being advocated by Col. W. E. MERRILL, U. S. Engineers, before the River and Harbor Committee of the House. By these dams Col. MERRILL contends he can make the river navigable all the year round. There would have to be four dams between Wheeling and Pittsburg, and the estimated cost is $920,000. They could be built in four years.

THE ALBANY ASSEMBLY CEILING SCANDAL is getting worse instead of better. Mr. C. B. BRUSH, C. E., a well-known civil engineer of New York, testified for the State that the original plans and specifications had been widely departed from; that the work looks unfinished; that the oak used was not "quartered oak" as called for in the specifications, and that in the spandrels papier-mache had been employed where oak was specified—a change that netted $9,000 to the contractor. The iron-work was short in quantity 60,000 lbs. Mr. BRUSH estimated the cost of the ceiling, exclusive of papier-mache, at $156,000, allowing $32,000 for contingencies and profit to the contractor. He says that the ceiling has already commenced to settle, thus indicating its weakness.

THE NICARAGUA CANAL CONSTRUCTION CO. has elected Senator WARNER MILLER, of New York, as President, the late President, A. C. CHENEY, becoming Vice-President. The continued accretions of "solid men" to the management give additional assurance that the project is to steadily go through to completion, and the latest reports from the canal itself are that the preliminary works are going forward rapidly and successfully. Admiral AMMEN reports that the dike work is being exceedingly successful, indicating that the harbor problem is not going to prove a hard one.

THE CORINTH CANAL has unfortunately shared the fate of the Panama, a judgment having been issued winding up the affairs of the company. LESSEPS' name has evidently ceased to be one to conjure with for either company, and it was found impossible to raise the further cash needed to complete the Corinth canal at present. There is this difference between the two enterprises, however, that the Corinth is already nearly completed, is a rational and feasible project, and the work done will not deteriorate by standing a while. Therefore, the Corinth canal is almost certain to be completed in the not distant future, while the Panama is certain not to be completed.

THE EMMENSITE AND GELBITE EXPLOSIVES were tested at the Washington Navy Yard on Mar. 11. As reported the ingredients were about equal parts of nitrate of ammonia, nitrate of soda and an acid preparation made of picric, cresylic, and so-called "emmens" acid. These were mixed on the ground and it was shown that it could be safely fired with a match and simply burned slowly. The first experiment consisted of blowing up a raft made by bolting together forty railroad ties, piled up in three courses. A cartridge containing about 60 lbs. of the explosive was fastened beneath it, and was towed out into the river, where the charge was exploded by electricity. Not a tie was left intact, and splintered pieces of wood were thrown at least 300 ft. into the air. Cartridges containing 7 ozs. of the compound were fastened above, below, and at the sides of suspended iron plates, five-eighths of an inch thick, and then exploded. In every instance the plates were broken. To show its safety from explosion by concussion, a rifle ball was fired through a large cartridge. A similar cartridge of dynamite exploded under the same treatment. A small tin case filled with the compound was also fired from a small yacht gun without being exploded. The gelbite is a chemically prepared paper, saturated with the emmensite, and rolled up into cylindrical shape for use in gun cartridges. Ordinary 45 calibre rifle cartridges loaded with this paper were fired alternately with ordinary powder cartridges. The recoil was very light, while the noise was scarcely more than that of a parlor target rifle, and the smoke, by comparison with the smoke of the powder charges, was scarcely appreciable. No provision had been made for measuring the initial velocity or the penetrating power of the projectiles, which were fired into a wooden target.

The Economical Disposal of Ashes and Other City Refuse.

BY WOLCOTT C. FOSTER.

From time to time notices have appeared in the papers speaking of the efforts of various persons to separate the useful ingredients of city ashes and refuse from that part which is absolutely of no value. So far as I can learn these attempts have met with indifferent success, though there is no reason why such an enterprise, if properly conducted and with the right kind of machinery, should not prove very profitable. In ashes as they are deposited at present on the dumping grounds of our larger cities, and especially where anthracite coal is the fuel, we have what might be considered a very rich ore indeed. It is already crushed and usually in an excellent condition for treatment. Of course its useful constituents are many, as we shall soon see, and they form a considerable part of the bulk of the crude material. Several years ago, while crossing a piece of ground that had been filled in with ashes, I was much impressed with the large amount of valuable material lying there, and was led to design the following combination of machinery for its economical mechanical separation.

The carts used in gathering the ashes are backed up to the car *A*, Fig. 1, and their contents emptied into it. The car holds about two cart loads. As soon as it is filled, it is raised on the elevator to the floor *B*, along which it is run upon a track to the hopper *C*, into which the ashes are dumped. They pass into the inclined revolving screen *D*, which is of such a mesh as to retain the tin cans and larger articles and still allow the stuff containg nearly all the cinder to pass through. The materials retained by the screen, such as rags, paper, sticks of wood, straw, iron (mostly tin cans), pieces of lead pipe, glass bottles, shells, bones, pieces of rope, twine, carpet, bagging, old rubbers, shoes, hats, large stones, etc., pass through the chute *E*, and over the revolving cylinder *F*. This cylinder is covered with sheet brass and has a number of electro-magnets within, so connected with a commutator, that as each eighth of the circumference passes the lowest point in its revolution, it becomes demagnetized and remains so until it goes beyond the point *G*, when it again becomes magnetic. By this apparatus, all of the iron is separated and falls upon the inclined plane *H*, and thence upon the conveyor *I*. If any of the pieces of metal happen to become magnetic enough to persistently adhere to the cylinder, they will be detached by *G*. The iron, consisting mainly of tin cans, is carried by *I* to the hopper *J*, from which it is automatically fed into the revolving furnace *K*. Here it is heated to the proper temperature, and at the same time strongly agitated, so that any solder which may have been used in joining any parts together is melted and jarred off, falling into the bottom of the cylinder and escaping by the slot *L* into the trough *M*. The solder is then led by this trough into a large iron pot, where it is allowed to collect until a sufficient quantity has accumulated. An examination of it is then made and the requisite quantity of tin or lead added, as the case may be, to bring it up to the desired standard, after which it is cast into bars or pigs ready for the market.

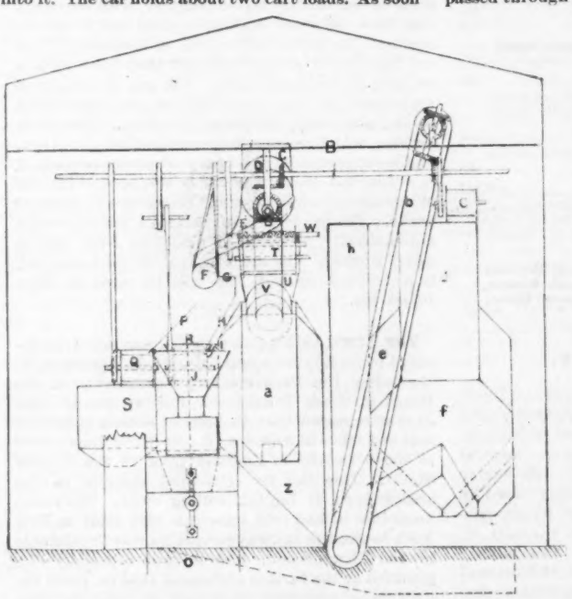


Fig. 2.—End Elevation of Machine for Sorting City Refuse.

The iron passes out of the end of the cylinder and falls upon the counter-balanced door *N*. As soon as the weight becomes enough the door opens and the load falls into the pit *O*. The door then immediately closes and the operation is repeated. The iron is removed from the pit to be used for making sash weights or any other purpose that may be found desirable.

The balance of the material passing through the chute *E* is not affected by the magnets, and consequently falls upon the inclined plane *P* and thence upon the conveyor *Q*. As the various things are carried along upon the conveyor everything of value is picked out by boys stationed along the side of it. Each boy has certain classes of material to pick out. The different classes are thrown into the bins *h*, each class having a separate bin. The substances having no value fall into the bin *S*.

To return to that part of the ashes which has passed through the screen *D*. This portion contains essentially all of the cinders, the fine ash and many of the smaller stones. It falls upon the conveyer *T*, and is carried to the hopper *U*, from whence it is fed into the screen *V*. As the stuff falls into *U*, it is sprayed with water by the pipe *W*, partly to prevent the making of dust but mainly to enable the sifting to be better done. Both of the screens *D* and *V* are encased in dust proof boxes, not shown on the drawing.

The screen *V* is divided into three parts, each of which is covered by screens of a different mesh. The first or one nearest the hopper is, of course, the finest, and separates out all of the fine ash and cinder. The material passing through this part of the screen falls into the bin *X*, and together with that in the bins *S*, *a* and *g* may be used for filling.

The second part of *V* has a somewhat larger mesh, while the third part has a mesh nearly, but not quite, equal to that of *D*. The object of these last two sizes is to separate the cinder-bearing material into two parts or grades for greater convenience in treating with the coal washer to be described later on. The respective portions fall into the bins *Y* and *Z*. That material—such as garbage, etc.,—which has been forced through the screen *D* by the weight of the superincumbent mass, and of which the greater part is of no value, passes from the end of the screen *V* into the bin *a*. The coal-bearing matter is taken from the bins *Y* and *Z* by the elevator *b* and carried up and dropped on to the conveyor *c*, by which it is taken to hopper of the coal washer *d*. Here, by the aid of water, the cinder or partially-burned coal is separated from the slate, stones, glass, garbage and other substances which may accompany it.

The elevator *b* is so arranged that it may be moved along the shafts to which it is attached, so that it will empty, say the bin *Z*, while the bin *Y* is filling, then when the bin *Z* is empty it is moved along so as to take the material from *Y* while *Z* is filling. The coal from the washer goes into the bins *e* and *f*, each size having its own bin, and is then ready for the market. The stones and other waste fall into the bin *g*, while any garbage or light substances go into *h*.

All the bins containing final products have sliding or trap doors so arranged that a wagon may be placed underneath them and loaded by merely opening one of the doors and allowing the contents of the bin to fall into it, thus dispensing with all extra handling.

It is calculated that from 40 to 60 per cent. of the

mass of the ashes as received would be merchantable. If such is the case, one can readily see that the saving in the cost of towage alone in removing the ashes from a city like New York, would amount to a very handsome sum in a year.

If now the rag pickers can be prevented from overhauling the ash barrels the percentage of available useful material will be greatly increased, and likewise so will the profits. In order to accomplish this end, and also to keep the streets much cleaner, especially in windy weather, it is proposed to supply the various houses with iron ash barrels of special design, having a cover which upon being closed, is fastened by a spring lock. These barrels would be furnished either free or at a very small price, on condition that the cover be closed before the barrel is placed upon the sidewalk. The ash collectors would have keys with which to unlock the covers so that the barrels could be emptied into the carts.

By this means the streets of the city would be kept in a much cleaner and better condition than at present.

The intention is to have stations similar to the one illustrated established at different points in the city, so as to bring the haul within a reasonable distance.

The following table gives some of the more important products, together with their average market price in New York City:

Substance.	Market value.	Use.
Coal and cinders	$1.50@$2 per ton.	For domestic use.
Iron	$5@$12 per ton.	Remelting for sash weights, etc.
Solder	13c. per lb.	
Rags	1c.@1½c. per lb.	Paper stock.
Paper	¾c.@1¼c. per lb.	
Bones and shells		Making fertilizers.
Brass	5c.@8c. per lb.	
Copper	6c.@9c. per lb.	
Zinc	3c. per lb	
Lead	3c. per lb.	
Pewter and other metals and alloys.		
Old leather		Several uses.
Old rubber	1½c.@5c. per lb.	
Bagging, rope, twine, etc.	1c.@3c. per lb.	Paper stock, oakum, etc.
Glass, bottles, etc.		Remelted in glass factories.
Straw, wood, etc.		Used as part of the fuel required in the works.
Stones, fine ash, etc.	5c. per cu. yd.	Limited use as filling material.

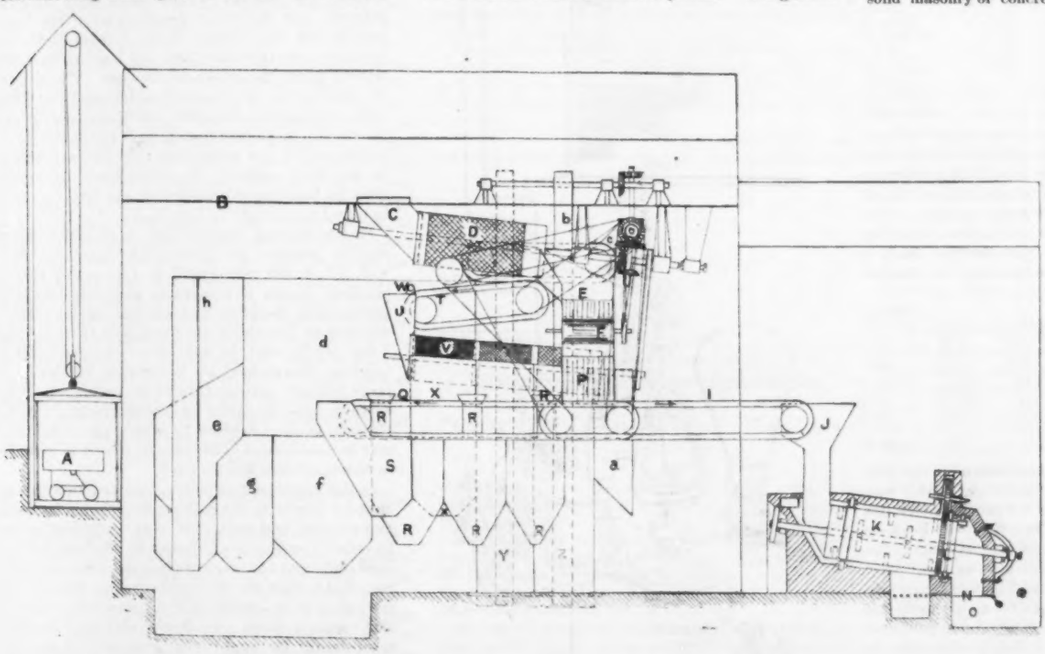


Fig. 1.—Side Elevation of Machine for Sorting City Refuse.

Railways in Asiatic Turkey.

The London *Times* recently stated that steps are to be taken for the construction of a railway through Anatolia, in Asiatic Turkey, under the auspices of the Deutsche Bank of Germany, and the Trustees, Executors & Securities' Corporation of England. The Sultan has shown his good will to the undertaking by assigning the revenues of four "sanjaks," including Angora, as a guarantee fund for the payment of the Government's share of the expense. Mr. Vincent Caillard, a member of the International Council of the Ottoman Debt, is on the Board. The road will extend from Ismid to Angora the capital city of Anatolia, 300 miles in the interior.

A railway from Scutari, the Asiatic quarter of Constantinople, to Ismid, 58 miles distant, has been in existence for several years, and has earned dividends. This line has been transferred to the Deutsche Bank, with the concession for an extension of 300 miles to Angora. Work has already been commenced, and will soon be completed to Ada Bazar, whence a branch will be built to the coal fields of Heraklia, on the Black Sea. The line is to be completed by October, 1892. The cost of a single track, including equipment, is estimated at less than $50,000 per mile. Eventually the line may be extended to Bagdad, Aleppo, or Damascus. From the Bosphorus to Angora is about 300 miles; and from Angora to Bagdad about 1,200 miles. About a third of this distance is said to be hilly country, where construction would be expensive; but the remaining two-thirds are said to be level plains. The guarantee on the old line was about $3,300 per mile per annum, while on the new line it is about $4,950 per mile per annum.

The region that will be served by this railway, as far as Angora, has an area of about 220,000 sq. miles, and a population of several millions. Angora has a population of about 40,000. The country is said to be fertile and prosperous, and capable of commercial development.

This line will be the beginning of a new route to India, practically identical with the Euphrates Valley Ry. project which has been suggested for several years. Another railway which is expected to compete for the construction of a line over this route, is the Ottoman Ry. (formerly the Smyrna & Aidin), which is owned by an English company. The present terminus is at Omer, 200 miles from the coast, and it is proposed to extend it across the mountains to Konia, where it would strike the great caravan road from Constantinople to Syria and the Euphrates.

Railways and Public Works in China.

That the railway question is still kept alive by the more intelligent and progressive government officers is evident from the statements published from time to time in China papers. The following abstract of an article in the *North China Daily News*, of Shanghai, Dec. 13, 1889, is of interest as showing something of the difficulties to be encountered, and the style of construction of some of the existing public works.

The question of railway construction is still simmering in the official mind. There are those who positively declare that an edict has been issued for the construction without delay of the Hankow line, or at least a portion of it, that is from Lu Kow Chiao to Paotingfu. We cannot altogether credit these rumors, but this we can safely aver: that the government has not abandoned the idea of constructing the Hankow line. An old Tientsin resident, now at home, sends the following notes referring to the news received at home of the Emperor having not only sanctioned the above line but having given orders for its immediate construction. His first advice is to get a thorough survey made by competent hands of the route intended to be taken. "Make plans and get specifications and estimates for the work, and above all let the work be done under competent foreign civil and mechanical engineers, honest and sober men. I have seen numerous works in China which from their outward appearance ought to have stood; but they had given away, and then was shewn the hollowness and instability of the different works. For instance, there was the stone embankment on the Hwen river, a little below Lu-kow Chiao (bridge) on the south side. This embankment appeared very strong, the stones being clamped with iron. When I visited it immediately after the disaster, I saw that the stones were mere facing and that behind this stone facing, instead of solid masonry or concrete, there had been nothing but loose rubble stones of small size, not bound together in any way, although mountains of limestone were within a few miles of the spot. By the destruction of this embankment several villages were swept away, crops destroyed over a large district, and several lives lost, and all this because the work was unfaithfully done. Numerous bridges I have seen in Chihli as well as at other places during my travels, where the work was scamped in like manner. On looking at the broken arches, the cause of the break I saw to be that there was *no foundation* to the bridges. On the bridges again, I found where the arches had parted asunder from the top, the cause being want of foundation on the one hand and on the top loose small stones without any binding of concrete or cement. The shape and form of the bridges and embankments was all that could be desired; but the unfaithful carrying out of the work, when it was supposed it would not be seen, caused its ruin. The line along the plain of Chihli, one would think, could be constructed at a cheap rate, but in many places this road will have to be raised on account of the heavy rainwaters from the mountains, and numerous small bridges for openings for this rain water must be made even on the plain. On crossing the rivers and streams you will perceive in many places that while in the dry season the stream is only a few yards or even a few feet wide, yet the sands show that in the rainy season nearly a mile or sometimes more must be covered by the waters. Such is the case among others at Lo River, between the Yellow River and Honanfu. Nearly all these waterways could be managed so that only moderately sized bridges would be necessary. Crossing the Yellow River where I crossed it, no expensive bridge would be necessary. A single arch of considerable width would span the main stream on the north side, with stone arches on the island, leaving only one foundation to be made in stream on the south side, this stream having but little or no current and about 6 ft. depth of water. Again, before we reach Hankow there is a good deal of loose land which must be either raised by embankment or masonry; but the whole work presents no engineering difficulty. Insist on honest labor, whatever be the expense and whatever the length of time it may take to finish the railway from Peking to Hankow. It will take a long time and cost a great deal of money at first, and until finished you will derive comparatively little income for your outlay, but the line is one of national importance.

Two Fast Runs.

The fastest run on record between Philadelphia and New York was made on Monday, March 10, by a special train over the Philadelphia & Reading and Central Railroad of New Jersey lines.

At 11.15 A. M. a Philadelphia firm of stockbrokers asked for a special train to carry a large amount of

Reading stock to New York to break the threatened "corner." In fifteen minutes Assistant General Superintendent BONZANO had made arrangements for the train and secured it a clear track. The start was made from the Reading station at Ninth and Green Sts. at 11.38, Bound Brook was reached at 12.34 and Jersey City at 1.03, so that the entire run of 90 miles was made in 85 minutes, or at the *average* rate of 63.53 miles per hour. The fastest time was made between Wayne Junction and Bound Brook, 55 miles, which was covered in 50 minutes, or at the rate of 66 miles per hour. At times on the run the speed is said to have exceeded 85 miles per hour. The train consisted of two cars only.

The engine which drew the train was No. 366, built at the Reading shops. She has a Wooton type boiler, and the following are the principal dimensions:

Number of drivers 4, diameter	68 ins.
Diameter of truck wheels	30 ins.
Cylinders	18½×22 ins.
Wheel base	20 ft. 5⅝ ins.
Boiler at smoke-box	53 ins.
" " fire-box	58¾ ins.
Number of tubes	345
Diameter and length of tubes outside	1⅝ ins. × 9 ft. 2 ins.
Inside area of tubes	514 sq. ins.
" length of fire-box	8 ft. 6 ins.
" width " "	8 ft.
Combustion chamber, length	31 ins.
Grate area	68 sq. ft.
Total heating surface	1,415 sq. ft.
Diameter of stack	18 ins.
Exhaust nozzle, variable	4 to 5 ins.
Weight on drivers	60,780 lbs.
Total weight of engine	89,750 lbs.
Length of engine	57 ft. 2 ins.
Capacity of tank (71 galls per in.)	3,000 galls.

Another extremely fast run was made between New York and Washington and return, 225 miles each way (as the run was made, omitting entrance to the Broad St. station in Philadelphia) on March 10, with the "Aunt Jack" dramatic company. The run to Washington was made in 4h. 24m., omitting a 3m. stop at Philadelphia, and the run back in about 2m. less time. The schedule of the run out was as follows:

	Miles.	Time.	Speed. m. p. h.
Jersey City	0	7:29	
New Brunswick	31	8:03	54.7
Trenton	57	8:28	61.1
Philadelphia	91	9:06 / 9:09	53.7
Baltimore	184	10:57	51.1
Washington	225	11:46	50.2
Average			53 15

This is almost exactly the same rate as in the best time in the famous "race to Edinburgh," which was 400 miles in 7h. 30m., or 53⅓ miles per hour. In one instance, at least, however, that run was made in 5m. less time. The trains were almost exactly the same in weight, being, in the case of the "Aunt Jack" train, two day coaches and a dining car. By this run the company was enabled to perform the unprecedented feat of giving an afternoon performance in Washington and an evening performance in New York on the same day. It was only a single performance, but the Pennsylvania could, no doubt, with great ease, make it a regular schedule rate for a month at least, as was done in the Edinburgh war. In fact, it was only by progressive efforts that the final speed in that run was attained, which, of course, is a much greater performance than this Washington run, in any case, since it is over nearly twice the distance.

The Hall Electric Pump.

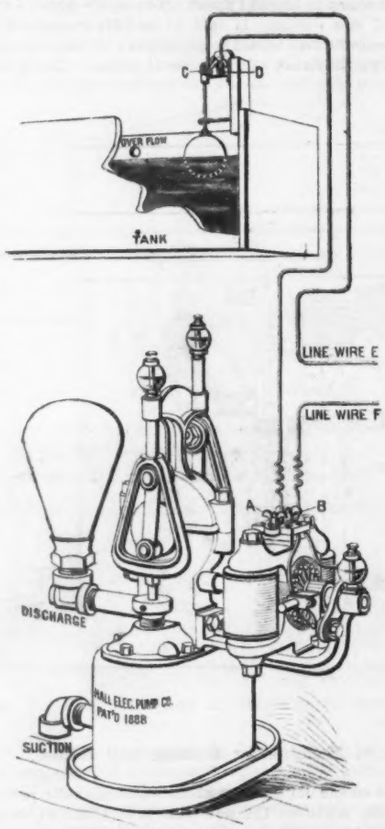
Some time ago we illustrated an older type of this same pump, and now show it in its new and much improved form. It is electric, running wherever power can be conveyed to it from a power plant. It is automatic in its action, always keeping the tank full, and is provided with an electric switch at the tank, operated by a float, which breaks the circuit and stops the pump when the tank is full. When the water level falls, the float again closes the circuit and starts the pump.

The pump is cheap in first cost, as compared to other pumps, and cheaper to run; it is noiseless, clean and perfectly safe. Experiments of Mr. EDISON, now in progress, strongly indicate that it will be but a short time before an independent battery will be put upon the market, powerful enough to run this pump. This will make it independent of electric power plant and widely extend its field of usefulness. The office and works of the Hall Electric Pump Co. are in Plainfield, N. J.

Notes on European Reservoir Dams.

A German engineer, Dr. P. KRESNIK, has lately been investigating the measures adopted for the safety of reservoir dams constructed across valley, in France, Spain, and Algeria. He has communicated his experience to a German publications *Wochenschrift des Osterreichischen Ingenieur- und Architekten-Vereines.* These dams, of which there are large numbers in the countries named, are constructed for the purpose of irrigation, water supply, driving water-wheels, or feeding canals. It is said that with a dam of moderate height, say up to 66 ft. there is little difficulty in providing for its safety. But, occasionally, dams 200 ft. high have to be constructed; and in such cases the greatest care is taken in carrying out every detail of the work.

In dealing with the foundations, Dr. KRESNIK points out that when the dams are of masonry they should be so bedded in the foundation soil as to form a homogeneous whole. This can only be perfectly attained if that foundation be rock, and as



The Hall Electric Pump.

examples are given the Almanza and Alicante dams in Spain, built 300 years ago. These are 68 ft. and 134 ft. high, respectively, are founded on rock and stand to this day; while the Puentes dam (164 ft. high), which was built not quite 100 years ago on alluvial soil was destroyed in 1802, after ten years' existence only, by a flood which never rose higher than 10 ft. below the crown of the dam. This structure was rebuilt in 1886; the foundation was considerably widened, and was carried nearly 80 ft. below the bottom of the valley, so as to reach the solid rock. The Grands-Cheurfas dam in Algeria is 98 ft. high. It is founded on limestone rock, but on the mountain slope, into which one end of the dam was built, a fissure filled with sand occurred. When the reservoir was filled with water in 1885, water passed through this fissure, and in consequence, after about a month had elapsed, a breach nearly 33 ft. was formed, through which the water poured, and the flood destroyed another dam further down the valley. The Gros-Bois dam, in France, was built on clay, which, becoming moistened as the reservoir filled, produced a sliding motion resulting in the bulging of the lower slope; this was partially removed upon the reservoir being emptied. The same effect was apparent in a more pronounced degree with the Bouzey dam, which is 72 ft. high. This bulged about 15 ins. on the lower side for a length of nearly 150 ft.

Speaking of the foundation of earthen dams, Dr. KRESNIK says they should be on an earthy soil, free from vegetable matter, in order that a thorough incorporation of the dam with the soil beneath may be secured. If the soil be not thoroughly impermeable to water it is usual to build a puddle wall in the body of the dam, This is in accordance with the practice of English engineers. A notable exception to this rule is quoted in the Marengo dam which is in Algeria. It is constructed of earth upon basaltic rock, and is 101 ft. high. Unusual precautions were, however, taken to prevent the filtration of water through the dam at the base. This has been thoroughly successful. A foundation curved in plan is used in the Spanish and in some of the French dams; but in Algeria a straight foundation is the rule. The former method is preferred, three of the straight dams having been breached. The cross section in masonry dams varies very much. Many of the old Spanish dams are said to be of unnecessary breadth, which may be explained by the fact that the old Spanish engineers made no allowance for the cohesion of mortar, the weight of the mass only being considered. On the other hand, many of the dams of France are too slight, their cross-sections being calculated on the basis that the highest water level will be below the crown of the dam. The breach in the Habra dam in Algeria is attributed to this mistake. In earthen dams the conditions are different; for the top is generally wide and the slopes flat. It is the rush of the water over the crown that has to be provided against; the calculation for stability must be made on the basis that the water level may be equal to that of the crown.

M. HETIER has pointed out in an article contributed to *Annales des Ponts et Chaussées*, 6th Series, Vol. XI., p. 615 (see also Vol. IX., p. 735) that the smallest fissure in a masonry reservoir dam is dangerous, and therefore no torsional strains should be admissible. For dams not exceeding 115 ft. in height "the profile may be the curve of equal nullity of tension, determined by horizontal sections. For large dams of greater height the pressure in oblique sections must be taken in consideration." And M. HETIER gives a method by which the outer profile may be determined in the case of a vertical inner face in treating upon this subject.

In dealing with methods of construction it is said that for masonry dams the stones should be dressed and squared and set in the best hydraulic cement. In order to reduce cost, however, the best mortar is used only near the faces of the dam, while commoner material is used for the central parts. Disasters following on such a method of construction are given. For earthen dams two-thirds clay and one-third sand should be used. The materials should be in thin layers sloping upward, rammed and rolled so as to be as water tight as possible. Each layer should be watered before the next is placed upon it. The English puddled clay core has the disadvantage that the parts in contact with it are liable to crack, and every precaution must be taken to prevent this.

Masonry and earth together are dangerous, as also are masonry culverts under high earthen dams. An example of this fact is afforded in the well known incident of the destruction of the Sheffield reservoir dam.

The water level limit should be below the crown of the dam, more especially with earthen dams. This may be secured by means of discharge channels, with head sluices working automatically, or by weirs. In the Almanza masonry dam, built 300 years ago, as already mentioned, there is a weir, the sill of which is 6½ ft. below the crown; it is 30 ft. wide, the catchment area being 77 square miles. The Habra dam has a weir 40 ft. on one side and 124½ ft. wide on the other side. The sills are 10 ft. below the crown, the catchment area being 91 square miles.

It is not often that a culvert has to be made through a mountain side, but an example is given in the Furens reservoir, constructed to supply the town of St. Etienne with water, and to protect it from inundation, at a cost of 1,570,000 francs, the sill of the tunnel being 24½ ft. below the crown of the dam. This dam, it may be noticed, was the first one of curved form built in France, although in Spain the dams are mostly of this construction. Scouring sluices are sometimes used for discharging flood

water. In the case of the Habra dam this arrangement led to serious disaster through the sluice shutters failing to act when the dam was breached, as already stated. The necessity of telegraphic communication between the dam and towns or villages in the valley below is pointed out. The importance of this precaution has been fully emphasized by the two great recent disasters in America, but the lesson was forcibly impressed in Europe many years before. In the year 1802 when the old Puentès dam was destroyed, as previously mentioned, the village of Lorca, situated about seven miles down the valley below the dam, was overwhelmed, and 680 people were drowned. Had there been telegraphic communication this loss of life would doubtless have been prevented, and in the new dam due precautions have been taken.

For the purpose of drawing off water a well is sunk to the bottom of the dam. In the Spanish system this well is put in communication with the reservoir by a number of small openings furnished with sluices, while the French engineers adopt fewer and larger communications. In the Gros-Bois dam, already referred to, there are only two openings. The well is drawn off from the lower side by means of a culvert passing under the dam. This is sometimes divided into two parts; in the Bouzey and Vingeanne dams in France there are two branch channels 2 ft. 7 ins. wide, and 3 ft. 3 ins. high, the main channel being 6 ft. 3 ins. wide.

For cleansing the reservoirs, scouring sluices are provided. In some of the Algerian reservoirs the annual deposit varies from 0.16 to 1.6 cu. yds. per acre of catchment area. The usual method of scouring the bed of the reservoir is by opening a large under sluice, when the rush of water carries off the silt. The Alicante reservoir was scoured in this way after an interval of ten years. The cost was £400 ($2,000), and 2,600,000 cu. yds. were removed. If allowed to accumulate, the silt becomes consolidated and is not easy to remove. In order to loosen the silt, CALMELS has introduced a system by means of which compressed air is blown on to the silt through a tube, which causes a stirring action, so that when the sluice is opened the silt is easily carried away by the rush of water. Another method, introduced by M. JANDEN consists of a pipe, one end of which rests on the deposit. At the other end is a suction pump, and by this means the silt is removed in an efficient manner, although at considerable cost.

A Novel Plan for the World's Fair Building.

Among the hosts of cranky suggestions for fair buildings, towers and what not for the proposed great fair of 1892 which have been appearing in end less succession in the daily papers for the past few months, we are pleased to discover one which gives both the great building and the tall tower in a truly original way, in no way offensive to good taste (as most of the suggestions are), and on the face of it by an entirely practical method. In theory and in the abstract, that is to say, the project in defensible, while its probable artistic and practical merit, if successfully carried out, is such as to demand that the details should be carefully studied out and considered before any other definite plan is decided on; and this is more than we have been able to say for any other of the novel projects of the kind which have so far been brought forward.

We borrow from the Chicago *Tribune* the accompanying outline sketch of the plan, which is a design of E. S. JENISON & Co., architects, of Chicago, and we leave Mr. JENISON to describe the project in his own way, at he does in the following extract from the *Tribune*, prefixing only that the design is to include the entire fair under one roof, covering 193⅓ acres, whereas all the buildings of the Paris Exposition covered only 75½ acres, and those of the Centennial at Philadelphia only 60 acres. Mr. JENISON says:

> Chicago cannot compete with the late Paris Fair in the architectural features of any buildings it might erect. We haven't the artists over here to do the work. We haven't the time. But Chicago can outrival Paris in a truly American way. It can build the biggest building ever built, one four times larger than any Exposition building of the past. And by constructing it without any inside columns it can produce, by the aid of electric lights, vistas of a magnificence never before dreamed of. Think of it—193⅓ acres under one roof and the whole interior open to the eye!

The scheme is claimed to be feasible, whether the site be the Lake Front and harbor or Jackson Park. A huge steel tower, capable of holding eight elevators and supporting the whole roof, is to be erected in the centre of a circle 3,000 ft. in diameter. From the top of this tower, 1,100 ft. high, steel cables are to be run out to the circumference. On these cables the roof is to be laid. The outer wall around the circumference is to be of brick.

The idea of the construction of such a building is simplicity itself. It is the idea of a tent enlarged to the necessary extent, with corrugated iron and glass substituted for the canvas covering.

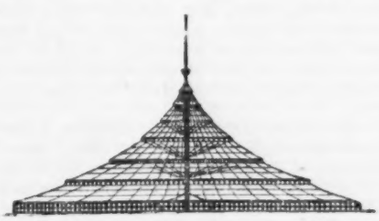
There is no doubt of the possibility of constructing such a building. A reference to the Brooklyn bridge, with a span of 1,560 ft., while the cables of this will be but 1,500, will enable one to form a comparative notion. The Brooklyn bridge will support a moving load of 100 lbs. per sq ft., while in this building there will never be a load of over 10 lbs. plus the wind pressure.

The wind pressure has been carefully considered. The conclusion reached is that it is perfectly practicable to resist the wind pressure on a round building by tension rods on the inside. In the first place a round surface does not offer as much resistance to the wind as a plane surface. Then the tension of the rods can be increased to any extent. The whole roof may be strung together on the principle of a bicycle wheel.

The building would provide for exhibition purposes under one roof 193⅓ acres. The area of the main floor would be 162 acres, and of two galleries, 75 ft., around the whole building, 31⅓ acres. The central tower is also to be provided with galleries at different stages, affording to visitors different bird's-eye views of the interior.

The best thing about this plan is the ample space it will give for entrance. If erected on the Lake Front the whole park may be used as a vestibute. If erected in Jackson Park, the circumference all around could be cut with openings.

A feature of the construction is that there is hardly any special material required. Railroad bars and rods, glass,



Proposed World's Fair Building.—E. S. JENISON & Co., Architects.

brick and tiling are almost the only materials. The cost on careful estimates would be $5,865,000, or $36,204 per acre of ground covered. This would be by far the cheapest main building of any exposition, the machinery hall at Paris having cost $75,080 per acre, the main building at the Philadelphia Centennial $73,591, the Crystal Palace, London, $42,500. Of this cost probably $1,000,000 would be afterwards realized on the old material.

The opportunities for embellishment and artistic display on the inside of the building would be unlimited. The roof at the central circle from the tower would be 700 ft. above the heads of the visitors on the floor. By day it would be a cloud. By night it could be made by electric lights a constellated sky.

A mile race track could be run around the circumference [Decidedly: A circle of 3,000 ft. diameter is 9,425 ft. in circumference, or 1.785 miles.—ED.] and foreigners could be treated to an exhibition of the competitive speed of our thoroughbreds. Surrounding the tower an amphitheatre larger than the Coliseum could be arranged, in which spectacles on a grand scale might be produced before a half-million spectators. The tower might be extended 500 ft. above the roof, thus out-Eiffeling Eiffel by an eighth of a mile, and the proceeds from a trip up its elevators, which in the Paris case went into private pockets, could thus be turned into the general fund.

The last mentioned consideration is one of unquestionable weight. Since the general feeling seems to be that there must be a tall tower, and since it would undoubtedly be a considerable source of revenue, and since this is the only plan of any kind for such a tower, so far as we have seen, that does not vary from the Eiffel tower only to vulgarize it, and in which the tower is not built merely for itself alone, as was the Eiffel, the idea of making the tower a necessary feature of construction, and so less objectionable artistically, is a pleasant one. It also leaves the revenue from it a net gain, and we should judge this revenue ought at least to pay for the cost of the great central tent-pole of the proposed vast roof, and so make it reasonable to eliminate that part of the cost of the structure from the cost of the building proper.

We must not be understood as endorsing this project. Architects are so apt to be weak in their strains in dealing with such great structures as this that we could only do this after careful examination of a detailed design. It is almost equally essential that the details of the estimate should be carefully scrutinized before accepting it. But the *conception* we hold to be a good one, architecturally inspiring, and mechanically an economical disposition of material. The central tower is necessarily and hence not vulgarly high, while, having nothing but vertical loads to sustain, it will not be expensive, comparatively speaking. The vast roof is supported in the most economical way, by cables in tension, and is made to serve not only its primary purpose as a shelter, but also the essential secondary purpose of staying the central tower. It is practicable to "resist the wind pressure by tension rods on the inside, in the sense of resisting *deformation by wind pressure*, but not in the sense of relieving the cables of the added strain therefrom, as seems to be implied by the language used; and it would be necessary to allow not less than 40 lbs. per sq. ft. for this wind pressure. Whether this allowance has been made in the estimates given above we cannot say. The estimates seem pretty low, and the proper anchorage of the roof cables of such a structure would be a very serious problem.

Forth Bridge "Specials."

Our English contemporaries, *Engineering* and *Industries*, both come out with enormous special numbers, detailing and illustrating the history and progress of the Forth Bridge. While both are exceedingly valuable and show much enterprise, the *Engineering* special is the most useful as devoting the most space to illustrations showing the engineering features of the work. Both journals give a map of the surrounding country and connecting railway lines, which is interesting to American readers, as showing where and why the Forth Bridge was built at all.

As *Engineering* shows in its historical sketch, this bridge is no new enterprise; a double tunnel was proposed in 1805, and in 1818, JAMES ANDERSON, civil engineer and surveyor of Edinburgh, presented quite elaborate plans for a suspension bridge 90 to 110 ft. high, and with spans of 1,500 or 2,000 ft. The numerous projects which preceded the structure as built have already been described in this journal and will not be repeated.

The history written for *Engineering* by Mr. W. WESTHOFEN, one of the engineers of the bridge, is very complete, and can not be even abstracted with justice to the writer or publishers; we advise our interested readers to secure it in full for themselves. But some general progress statistics, etc., can be condensed with profit.

The contract for this bridge was signed in December, 1882, and a start was made with the very extensive preparatory and temporary work required. On Inchgarvie the first work was commenced during April, 1883, by building a landing stage, etc., and on June 22, 1883, the rock excavation was commenced on the north east caision. The north east pier was finished on Nov. 17, 1884, and the north west pier on March 18, 1885. The south east pier was completed Nov. 20, 1885, and the south west pier on Feb. 22, 1886. On the four Fife piers work was commenced in 1883, and they were finished between September, 1884, and August, 1885. The four South Queensferry piers were commenced between May and December, 1884, and completed between July, 1885, and June, 1886, with different dates for each of the four piers.

In the 12 pier caissons at Queensferry, Inchgarvie and Fife, the amount of metal work was about as follows: Steel in the cutting edge of the caissons, etc., 401 tons; steel holding-down bolts, 110.6 tons; iron in the caissons, 2,360 tons; iron in the bolts, 152.5 tons, and cast-iron anchor plates, 151.3 tons. The total amount of masonry in viaduct piers, arches and abutments to Nov. 30, 1889, was: concrete, 64,315 cu. yds.; rubble, 48,350 cu. yds.; rock-faced granite, 494,642 cu. ft.; dressed granite, 140,756 cu. ft., and bond courses, 105,180 cu. ft. The grand total amounts to 140,100 cu. yds.

The original estimated quantity of steel required was 40,000 tons; but alterations made in the design demanded 16,000 tons more, not including in this estimate the viaduct material which amounted to

3,200 tons. The total of steel used in the bridge proper and the approach viaduct was thus 50,200 tons. About 6 per cent. of the total steel was returned as scrap. About 4,200 tons of rivets were supplied, and the estimated number of rivets is 6,500,000, varying in diameter from 1¼ in., for the heavy tubes andskewbacks, to ¾ in. for the buckle-plates; the length of the rivets varied from 11½ in. (measured under head) to 1¼ in. The greatest thickness of plates riveted was 9 ins., at the top junctures at the head of the vertical columns in Inchgarvie.

The erection of the superstructure of the Forth Bridge was commenced in 1885, and finished in 1889. The amount of steel erected and riveted in the last three years, 1887-89, was 10,536 tons, 18,379 tons, and 14,850 tons respectively; 512 tons had been riveted up on Jan. 1, 1886, and 6,227 tons were riveted in 1886; added to the first quantities, we have a total of 50,513 tons riveted up on Jan. 1, 1889. There still remained at that date 445 tons to complete the bridge proper, or 50,958 tons in all. In the main spans this quantity was divided as follows: Fife, 16,129 tons; Inchgarvie, 18,698 tons, and Queensferry, 16,129 tons.

The total cost of the Forth Bridge may be thus tabulated:

Amount expended on bridge and approaches, but not including connecting lines	$12,746,000
Amount expended in connection with Sir THOS. BOUCH'S suspension bridge, including Parliamentary expenses	1,250,000
Parliamentary expenses of cantilever bridge, engineering expenses, interest during construction	1,890,030
Total to Jan. 1, 1890	$15,886,030
Estimated to complete and paint	259,000
Total cost	$16,136,030

It is estimated that the sale of plant will realize fully $600,000. On the Fife, Inchgarvie and Queensferry piers, for all above the top of the circular foundation piers, the amount of wages paid to men and officials in charge was £344,810, or about $1,724,050, up to Nov. 30, 1889. The amount of steel erected in this time was 70,064 tons. The cost of labor for that amount of work was thus £6 17s. 9d. per ton erected and riveted up, or say $33.30. The total amount of wages and salaries paid to Jan. 1, 1890, was £1,045,000; say, $5, 25,000.

Steel Water Pipe.

Steel pipes as a substitute for cast-iron now form an important item for the engineer's consideration in Transvaal works; inasmuch as during the past year the transport from Kimberley to Johannesburg, a distance of only 300 miles, cost not less than $150 per ton at the time of the drought, and even in good seasons the cost of transport per ton is as much as from $60 to $75, consequently any substitute for the heavy cast-iron pipes is a desideratum. Steel pipes are being adopted because they are only about one-quarter of the weight of cast-iron pipes of the same internal diameter, and they are less liable to fracture than cast-iron. For the water supply of the city of Pretoria, James Russell & Sons, of Wednesbury (England), have obtained the contract for manufacturing some 27 miles of steel pipes for this particular supply. The same firm supplied the pipes, or a portion of them, for the Kimberly waterworks in Cape Colony, which have done good service. The consulting engineers for the Pretoria waterworks are E. Pritchard & Co., of Birmingham, who are also the engineers for the proposed scheme for the supply of the water to Johannesburg and neighboring gold mines, where over 4,000 tons of pipes will be required, as well as for the water supply of Klerksdorp, another prosperous town near to Potchefstroom, and second only to Johannesburg.—*The Engineer.*

A CORRESPONDENT writes us: "The following formula for ordinates is convenient. I do not know with whom it originated:

Formula: $O = \frac{1}{8} n n^1 D$,

in which n and n^1 = subchords (in stations), and D = degree of curve."

For the middle ordinate this becomes $O = \frac{1}{8} n D$, in which n = the *half* length of the chord. For the quarter points we obtain

$$O_4 = \frac{1}{8} 0.25 \times 0.75 \times D = 0.1641 D, \text{ etc.}$$

The formula is a useful modification and extension of the general formula for offsets or ordinates, $O = \frac{1}{8} n^2 D$, which has been given in Mr. WELLINGTON'S Field Book.

Foreign Road Construction and Maintenance.

[*Continued from page* 197.]

Belgium.—The roads of Belgium are divided into (1) State; (2) Provincial; (3) Conceded; (4) Vicinal. The first three classes are administered by the Ministry of Public Works, and form *la grande voirie* or high roads. The fourth class, or *la petite voirie*, is subdivided into two minor classes which will be described below.

Provincial roads are constructed and kept in repair by the provinces, by means of subsidies paid by the Government and communes. But since the extension of railways over the country, the provinces no longer build new roads, but content themselves with keeping in repair the 893 miles now in existence. The technical work is usually done by the engineers of the "Ponts et Chaussées," lent to the provinces on the payment of a small sum from the provincial treasury. These provincial roads usually connect towns of secondary importance.

Conceded roads include about 210 miles in total length, which have been built by private enterprise under 90 years concessions from the Crown. At the expiration of this term the roads revert to the State. The *concessionaire* binds himself to keep them in repair, and in return is allowed to collect a toll.

Vicinal roads consist of those belonging to communes, including the streets of towns and villages not declared part of the highway system.

The state roads are constructed and maintained by the Government Engineers, or the "Corps des Ponts et Chaussées." This is a body of nearly 200 officials of ten different grades; and together they form a department under the Minister of Public Works, and have charge of roads and buildings, hydraulic work, mines and railways under construction. Their salaries range from $1,800 per year to each of three inspector-generals; to $1,000 for first-class engineers; $600 to sub-engineers; $640 to first-class "conductors;" $450 to third-class conductors.

The total length of highroads in Belgium is 5,286 miles, and of these 76 per cent. are "State" roads. The Minister of Public Works, guided by the advice of the local authorities, decides whether a new road shall be built or not, and when it is sanctioned the State Engineers draw up a plan of the proposed road, which must then be exposed to public inspection in the Provincial Government House. A commission is also appointed to hear objections to it. If the commission approves the road it is sanctioned by a State decree which, together with the estimate of cost and schedule of conditions, must then be published in the local papers for the purpose of inviting bids.

The highroads are from 46 to 52½ ft. wide (14 to 16 m.), with a central roadway paved with stone blocks bordered by two side roads. The paved portion is usually very rough and is only suitable for carts and wagons. The later roads, being of minor importance, are only 29½ ft. wide, with each of the three roads occupying one-third of the width. Three provinces only have good macadamized roads.

The repairs and maintenance of State roads are conducted under contracts with very strict specifications. These contracts are usually for five years but may be terminated at the end of three years, with six months' notice from either party. The provincial roads are also cared for by contracts which require the contractor to take care of the paved portion and the trees. The side roads are kept in order by roadmen appointed by the Chief Engineer of the province, and they are paid $12 per month; each man has a section not exceeding 9.3 miles in length.

The vicinal roads are maintained at the cost of the communes. If the ordinary revenues of the commune are insufficient for this purpose, the roads are repaired by forced labor and special taxation. The first takes the form of two days labor contributed by each head of a family, and two days labor of each horse or ox in the commune, the latter to be supplied with a driver by the owner, who also furnishes carts. The rate-payer is given due notice, and may convert his "labor" into money according to a fixed schedule. At least one-third of the money spent on vicinal roads must be raised on direct taxes, and the money set aside as a special road fund. Any commune remiss in its road work, may have this work done by the higher authorities and then be forced to pay the cost. The communes charge a uniform toll of 1 ct. for every pair of wheels; 2 cts. for every horse or mule, and 1 ct. for every ass or ox in harness.

No particulars are given of the detailed methods of constructing roads. For 1882, the estimated expenditure on all roads, State, provincial and commune, was $5,120,000. The cost of building a new road 8 m. or 26.24 ft. wide, with a paved centre 5 m. or 16.4 ft. wide, is put down at $12,800 per mile. The new macadamized roads, with 11.8 ins. of metalling, cost from $5,070 to $6,020 per mile. The annual cost of maintaining paved and macadamized roads is officially estimated at from 1.2 to 2.2 cts. per sq. yd.

English Engineering Societies: Papers at the Meeting of the Institution of Mechanical Engineers.

(FROM A LONDON CORRESPONDENT).

There are in England three great engineering societies, whose London meetings call together engineers from all parts of the country. These are the Institution of Mechanical Engineers, the Institution of Naval Architects, and the Iron & Steel Institute. This list does not include the most important engineering corporation of all, namely, the Institution of Civil Engineers. The latter body, however, have a different scheme for arranging their meetings. In place of having one or two important London meetings in the year, with another meeting in the provinces in the summer, they hold, during the season, a weekly meeting for the reading and discussion of papers. This plan has advantages but it does not call together country members to the same degree that the less frequent meetings are apt to do.

Another reason why the meetings of the Institution of Civil Engineers are less popular is that they are not reported. The council of the institution taboo reporters altogether; and visitors are only admitted to the meetings on the express condition that they write nothing about them. When a man speaks at any of the first named institutions he feels, if he says anything worth repeating, that it will be reported to the engineering world at large through the medium of the engineering press. A speaker at a meeting of the Institution of the Civil Engineers, however, knows he only addresses the audience present. It is true that the seecretary of the Institution of Civil Engineers sends out to the press a brief abstract of any paper about to be read; but this is merely the dry bones of the matter, and is generally relegated by editors to a small type corner. Of course when the proceedings of the institution come to be published, the discussion on any paper appears in full; but this is not until many weeks have elapsed, so that the interest has often evaporated, and even then the proceedings only go to members and associates.

That the institution still continues to flourish, in spite of this lack of popularity to be obtained through the press, says much for the manner in which it is conducted. What will occur when the institution loses its present vigorous and able secretary—a man of truly wonderful genius for organization—remains to be seen, for Mr. FORREST'S term of office cannot last for ever.

It is, however, with the kindred institution, the Mechanical Engineers, that we have to do at present. The names of all classes on the roll of the Institution of Mechanical Engineers at the end of last year amounted to a total of 1856. The receipts during the year were $30,314, and the expenditure $23,567. This leaves a balance of receipts over expenditure of $6,747. The Institution has now a capital of $154,340 invested in its name. The annual subscription for members and associates is £3, the entrance fee being £2. Graduates pay £2 a year and an entrance fee of £1.

The Institution is not very magnificently housed, having simply a modest suite of offices in Victoria street, Westminster, for which is paid the sum of £550 ($2,673) a year. It is in this matter of a local habitation that the Civil Engineers have so great an advantage over the other bodies, for not one of the three mentioned has a theatre large enough to meet in. The council of the Civil Engineers, however, always extend the hospitality of their theatre, which is fairly comfortable, to the Mechanical Engineers and the Iron and Steel Institute, the richer and older institution, thereby adding greatly to their own prestige and popularity.

The Naval Architects and the Iron and Steel Institute are not even so well housed as the Mechanical Engineers, and there has been frequent talk of the important institutions representing engineering science joining forces and building a worthily representative science house on some convenient site, say on the Thames embankment.

The accommodation the civil engineers have at their command is notoriously insufficient for their purpose, and if that body would take the initiative the thing would be done. The council of the civil engineers are, however, somewhat haughty and exclusive, but beyond that there is a difficulty with regard to funds, for some of the not unimportant societies have but a very small surplus. Still the thing ought to be done.

The Institution of Mechanical Engineers held their first meeting of the year—the forty-third year of their existence—on the last three days of January. The sittings were held each evening, as usual, in the theatre of the civil engineers, and there were three papers set down for reading. The first was "On the Compounding of Locomotives Burning Petroleum Refuse in Russia," and was contributed by Mr. THOMAS URQUHART, an Englishman, who is Locomotive Superintendent of the Gratz & Tsaritsin Ry., which is situated in South Russia. This is one of a series of papers Mr. URQUHART has contributed to the Institution on the improvements in locomotive practice which he has initiated on his line. In the southeast of Russia coal is scarce and petroleum is plentiful, consequently petroleum refuse is used as fuel in the locomotives, as it is on the steamers of the Caspian Sea. Mr. URQUHART has been very successful in devising apparatus for the burning of this liquid fuel. Those who are interested in the matter will find the mechanism very fully described and illustrated in recent volumes of the proceedings of the institution. [Mr. URQUHART's last paper dealt with "Compound Locomotives."]

In 1886 Mr. URQUHART made a trial of the compound system by altering one locomotive, and, briefly stated, the result may be said to have been a saving of 22 per cent. of the petroleum fuel burnt. This was sufficiently satisfactory, and in order to carry the experiments further, other locomotives were tried. In December last Mr. URQUHART had in daily use 12 compound goods engines with 6 wheels coupled, and 3 compound passenger engines with 4 wheels coupled. There were others in the shops in course of alteration, and so satisfactory is the compound system found to be, that the whole of the engines will be compounded as soon as the appliances at Mr. URQUHART's disposal will enable him to carry out the work. As a result of further experience Mr. URQUHART puts the fuel economy due to compounding down at 18½ per cent.

The current of engineering opinion here, on the whole, is decidedly in favor of compounding locomotives, and it is said by the advocates of the system that about twenty per cent. of fuel is saved by its adoption. If this be true it is surprising that the fact should not have been found out earlier. It is, however, difficult to believe, and even if there be a saving of 20 per cent. in fuel there must be other points to set off against this, such as increased first cost, complication of parts and perhaps additional lubrication. Mr. WEBB, of Crewe, the locomotive superintendent of the London & Northwestern Railway, was the first to try the compound system for locomotives on a large scale in England, and he has been followed by Mr. WORSDELL, of the North-eastern Railway, who is deservedly looked upon in this country as a high authority on locomotive practice. On the other hand Mr. STERLING, of the Great Northern, a veteran engineer of high reputation, and Mr. JOHNSON, of the Midland, have little belie, in compounding locomotive engines; while again Mr. HOLDEN, of the Great Eastern, is a supporter of the compound system.

This clashing of the authorities is a condition normal to the introduction of any innovation in engineering practice. We had the same thing in marine practice when the compound engine was proposed, and again when triple expansion engines were introduced. Doubtless the compound locomotive will make its way, and as it gets better understood it will show to greater advantage; but those who argue that, because compounding has been so manifestly a success in marine and stationary practice, it will pay equally well on locomotives, may find reason to modify their claims.

In the first place a compound engine to work to advantage—to get the benefit of compounding, which arises from a reduction of, and due proportioning of, the range of temperature in each cylinder—must have the work properly divided between the cylinders. Now, if a compound locomotive be designed to work to advantage when drawing an ordinary train load on the level, it is evident that it will be sadly out of proportion if it has an extra load to pull up a steep incline; while again, when running down hill with the regulator closed, it will not matter much whether the engine is compound or simple. That is the chief argument against compounding locomotives—the varying nature of the work. "But," say Mr. WEBB and his deciples, "how do you get over the practical result of 20 per cent. saving in fuel shown by the records obtained in practical work with compound locomotives?" Mr. TOMLINSON, President of the Institution of Mechanical Engineers, and Locomotive Superintendent of our underground railway, undertakes to answer that question. On his line 32 lbs. of coal per train mile are allowed to drivers as a standard, and if they can save anything out of that they are allowed a premium. The firemen have also an allowance for saving coal. Some men make a very handsome thing out of this, working down to as low as 26 lbs while others do not average lower than 40 lbs. This is due entirely to the varying capability of the men, not to the engines, for the men and engines are constantly changed. It is found to be the human, not the mechanical, factor which governs the result. This is in pretty general accordance with the experience of other railway engineers in this country, and Mr TOMLINSON very plausibly argues that the saving experienced in compounding locomotives is due to better driving and firing rather than to any intrinsic merits in the compound system for locomotives. Mr. WEBB, Mr. WORSDELL, and other gentlemen who take up the system are naturally anxious to justify their position, and therefore they do not pick out the biggest fools to run their engines. These compound locomotives are new things and the men who are chosen to drive them enter into the spirit of the thing. They look on themselves as a *corps d'élite* chosen by a "the governor" for their superior attainments. They are always in trial trip form. "That," say the more conservative simple-engine believers, "is the secret of the 20 per cent. saving. It is the human factor."

We may, however, point out that Mr. URQUHART's engines, burning liquid fuel, are fired automatically, so that skill in stoking does not count. It should also be added that Mr. URQUHART did not increase his pressure when he compounded, so that frequently disturbing element does not arise.

On the whole it would appear that the advocates of the compound locomotive have made out a sufficiently strong case to justify locomotive engineers in adopting the system, if they can see their way to get over the difficulties incidental to the arrangement of the mechanical details with sufficient ease.

COLONIAL COAL.

The second paper on the list at the meeting of the mechanical engineers was also on a railway matter, and referred to the burning of colonial coal in the locomotives of the Cape of Good Hope Government railways. The author was Mr. MICHAEL STEPHENS, who is chief locomotive superintendent to the railway. The paper dealt at length with the coal resources of the South of Africa, which are of great extent, although as yet they have been but little developed. The coal appears to be of pretty poor quality, which is the general characteristic of outcrop coal all over the world, so far as the writer's experience goes. Up to the present the mining operations, so called, have consisted mostly of shallow workings, but there appear to be some "mines," at least the expression is used in the paper, and doubtless from these the best of the coal referred to by the author is obtained. On the whole it would seem that there are boundless possibilities in the working of the South African coal fields, so that a mining engineer of energy and resource would be likely to do well.

It is not, however, the coal fields of this distant British colony that are likely to interest Americans who have such vast resources under their own flag still undeveloped. It is in the appliances used for burning this bad coal that the readers of ENGINEERING NEWS are likely to be interested; for the writer remembers there is some bad coal in the United States. He has a lively recollection of the prophecy about Rhode Island coal, which, he was once told, will be the last thing to succumb when the second and final destruction of this orb is effected by fire, in accordance with biblical promise.

The South African coal contains 29 per cent. of incombustible matter, and this becomes partly fused forming a pasty mass underneath the incandescent coal on the bars. Many attempts were made to get rid of this by tipping grates, rocking bars, and other mechanical contrivances, but these were all failures, and hand labor was the only resource. The foremen were selected for strength and powers of endurance, the fire bars were spaced 3 ins. apart, and the semi-fused dross had to be continually pushed through with a pricker. The work is described as closely akin to that of puddling; whilst occasional halts had to be made to remove masses of dross which had become set. The line abounded in gradients of 1 in 40, with curves of five chain radius; and, as the locomotive steamed along at night, it left behind it a fiery trail like that of the monsters of classic fable.

The selected firemen of strength and powers of endurance were soon used up at this work, but the right man turned up at the right time in Mr. J. D. TILNEY, locomotive superintendent of the Eastern system of the Cape Government railways. He devised a mechanical arrangement which was found to be quite effectual. The fire bars, which are of cast-iron, are spaced 1⅛ ins. apart, and rest on racks placed near their ends. They have serrated tops. Alternate bars are made 1⅛ ins. shorter than those adjacent to them, and each of the former have a lug projecting downward. A long pin goes through the lugs, and also through the ends of two connecting rods which pass forward and are attached at their fore ends to crank pins on a drum. This drum can be brought in contact with another drum fixed to the fore axle of the locomotive by means of a hand lever and chain-brake arrangement under the control of the driver. It will be seen that by putting the mechanism in gear, the drum on the axle causes the second drum to revolve, and this, acting as a crank, gives the connecting rods a movement which causes a reciprocatory motion of 1⅛ ins. to each alternate grate bar. The dross which has settled on the serrations of the grate bars being cooled by the air from below, is broken up when the bars are put in motion. The dross, it should be stated, is friable, and not hard like ordinary clinker.

This apparatus has been found to act efficiently and has rendered the working of the line with this common coal, containing 29 per cent. of dross, quite easy and successful. Possibly devices of a similar nature may not be unknown in countries where poor coal has to be used. In England we have so much good coal that the invention appears novel to our locomotive engineers; although, of course, we are familiar with the general principle involved as applied to stationary practice.

THE EXTRACTION OF OXYGEN.

The last paper on the list was one of great interest. What may be called a new industry appears to be arising in England. This is the extraction, as a commercial product, of oxygen from the atmosphere. Of course a certain amount of oxygen has always been "made," to use the popular expression for laboratory and minor purposes; but here we have a company which proposes to extract oxygen for use in heavy industries. The paper by Mr. MURRAY, read at the meeting, described the plant by which the oxygen is extracted.

The summer meeting of the Institution of Mechanical Engineers will be held at Sheffield this year. If the Sheffielders receive their guests with a liberal spirit, that is to say liberal in the way of throwing open their works to inspection, the meeting ought to be a most instructive one; for there is no district in England more interesting to Engineers than this ancient mechanical and metallurgical centre.

THE PENNSYLVANIA R. R. Co. is proposing to expend about $1,500,000 in removing twenty grade crossings within the limits of Philadelphia. These crossings are on the New York Division of the road.

The Georgia Southern & Florida Railroad.

One of the longest and most important lines of railway built in the South during 1889 was the extension of the Georgia Southern & Florida R. R. south to Palatka, Fla. The Georgia Southern & Florida R. R. Co. was incorporated Sept. 28, 1881. Surveys were commenced in January, 1887, and the contracts for construction were let in June, 1887, to the Macon Construction Co., which began work the same month. During 1887, 10 miles of the line from Macon, Ga., south were completed, and in 1888 140 miles more were finished, bringing the road nearly to Valdosta, Ga. During 1889 and 1890 the work of construction has been steadily pushed by the contractors, and the line was completed last month to its southern terminus at Palatka, Fla., 285 miles from Macon.

The work was generally light. The maximum grades were 52 ft. per mile, and maximum curve 4°. The grades are compensated for curvature.

The country transversed by the road is what is known as the long-leaf yellow pine forest region almost the entire distance. This land, after being denuded of the timber, is very productive, and is especially adapted to the growing of cotton and truck gardening for the Northern markets. The company's policy is to develop the land contiguous to its road as much as possible and thus to increase the local business of the road. In furtherance of this policy a large experimental farm has been established near Tifton, Ga., where it is proposed to raise all the staple crops of Georgia and ascertain what crops can be most advantageously cultivated. From the timber districts a large traffic in lumber and turpentine is expected. A large number of sawmills and turpentine distilleries have already been established at various points along the road.

The company will obtain an independent outlet to the West by the Macon & Birmingham R. R., now in process of construction. The Macon & Birmingham R. R. Co. was incorporated in 1889 and contracts were made the same year with the Macon Construction Co. for the construction of the road, which is to run from Macon, Ga., to Birmingham, Ala., a distance of 230 miles. The contract was sublet to J. S. McTighe & Co., of Memphis, Tenn., and work is now in progress. It is expected to have the line completed from Macon to La Grange, Ga., where connection is to be made with the Atlanta & West Point R. R. by Jan. 1, 1891. The work is quite heavy; maximum grade 1 per cent. and maximum curve 5°.

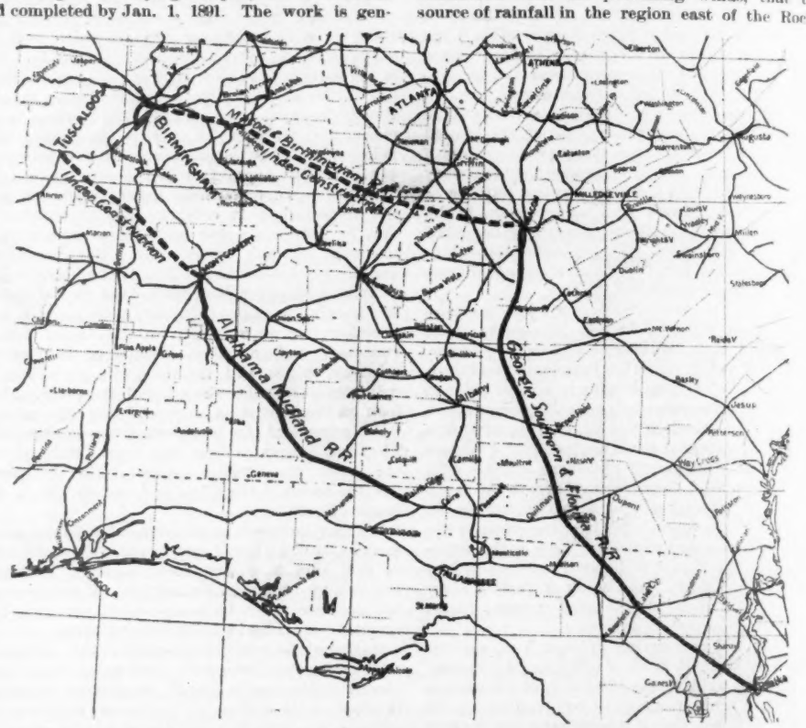
In addition to the M. & B. R. R., the company has let contracts for a branch from Tifton, Ga., to Thomasville, Ga., 52 miles, and will, it is stated, commence construction at an early date. The route of the new system is through a portion of the South containing few railways, and it cuts at right angles nearly all of these. In addition to the local traffic from a rapidly developing country the road will furnish a short line for the mineral products of Alabama to the Atlantic coast cities of Florida, and will open up the extensive forests of pine in southern Georgia to the Northwest. The road will also obtain a large share of the winter passenger traffic to Florida. The officers of the company are: President, W. B. SPARKS; Vice-President, H. J. LAMAR, JR.; Secretary and Treasurer, H. L. JEWETT, and Chief Engineer, W. H. WELLS.

The Alabama Midland Railway.

One of the longest lines of railway now under construction in the South is that being built by the Alabama Midland Railway Company, and projected to extend from Bainbridge, Ga., to Tuscaloosa, Ala., a distance of about 285 miles. The company was chartered both in Alabama and Georgia in 1887, and during that year the road was placed under survey, and preliminary lines were run from Bainbridge, Ga., to Montgomery, Ala., and from Chattahoochee, Fla., to Montgomery, the first being selected as the route for the road. In September, 1888, the Northwest & Florida Ry., running from Montgomery to Luverne, Ala., 51 miles, was purchased, and in October the Alabama & Georgia corporations of the Alabama Midland Co. were consolidated into one corporation, which assumed control of the properties of both companies. The route of the line was now changed to run from Bainbridge to Ada., Ala., a station on the Northwest & Florida Ry., a distance of about 140 miles. The necessary surveys for the change of route were made, and the contract for building the line was let to James M. Brown & Co., of 115 Broadway, New York City.

Grading was immediately commenced and the work rapidly pushed; tracklaying commencing in February, 1889, and the road being completed from Bainbridge to the Chattahoochee River, 30 miles, in May. Since that time the work has progressed rapidly, the track being laid as fast as the grading permitted; 117 miles of the road being completed during 1889 and the remaining 23 miles since that time. The work has been generally quite heavy, there being several large cuts and considerable bridge work. Besides the work on the new line, the Northwest & Florida R. R. has been changed to standard gauge and other improvements made on the roadbed.

During the summer of 1889 engineers were put into the field, and an extension of the road from Montgomery to Tuscaloosa, Ala., a distance of 106 miles, was located. The contract for building the extension was let to the same firm that was building the line from Bainbridge to Montgomery. Work is now in progress on this division. The company expects to begin tracklaying in April, and to have the road completed by Jan. 1, 1891. The work is generally easy; maximum grade, 66 ft., and maximum curve 6°. There is one tunnel on the line 875 ft. long, and an 800 ft. bridge over the Alabama River.



Map Showing Location of Georgia Southern & Florida and Alabama Midland Railroads.

The road has been built by the Alabama Terminal & Improvement Co., of which J. M. WOOLFOLK, of Montgomery, Ala., is President, in the interest of the Plant Investment Co., and with the object of furnishing the railways controlled by that company a line to the mineral fields of Alabama. That the line is likely to be a paying addition to this system is probable. The route is through a region now practically without railways, and which is said to be capable of great development agriculturally. The country is now but sparsely settled, however, and is capable of affording but little local traffic other than lumber. This, with the through traffic, will constitute the main business of the road at present. The President of the company is O. C. WILEY, of Troy, Ala. ARTHUR POU was Chief Engineer of the company up to the beginning of 1889. He was succeeded by H. A. SCHWANECKE.

A SUCCESSFUL FINAL TEST of the guns of the dynamite cruiser Vesuvius, was made on March 13, near Chester, Pa. Three "live" shells were thrown to a distance of one mile, with satisfactory results.

The Normal Monthly Rainfall in the United States.

Capt. H. H. C. DUNWOODY, 4th Artillery, U. S. Army, has presented to Gen. A. W. GREELY, Chief Signal Officer, a series of charts and tables showing the normal monthly rainfall in the United States.

The charts exhibit the normal amount of precipitation occurring within the limits of the United States, and they are based upon observations collected from 2,000 well-distributed stations at present furnishing monthly reports to the Washington office. The period covers, as a maximum, 18 years; and the normal values for the 18 years in other cases are determined by interpolations from monthly rainfalls at adjacent stations.

Under the head of the distribution of rainfall, taken for the year, it is shown that the amount of precipitation varies in the United States from about 3 ins., in Southern California, Western Nevada and Arizona, to over 100 ins. in the extreme northwestern portion of Washington Territory; the annual rainfall at Neah Bay amounting to 105 ins., the highest on record for a year. The charts indicate, when considered with the prevailing winds, that the source of rainfall in the region east of the Rocky Mountains, and probably for the southern and central Rocky Mountain districts, is the vapor supplied from the Gulf of Mexico and the Atlantic. The country west of these mountains is watered from the Pacific. It is also apparent that there is no decided increase in the annual precipitation in the region of the Great Lakes; though there is an apparent slight increase in Northern New York and the western portion of Michigan. The Great Lakes, however, have a more marked influence upon the temperature; they increase the cloudiness and the number of rainy days.

Capt. DUNWOODY points out that there are two well-defined systems of precipitation in the United States, as marked by the Rocky Mountains, as before mentioned. As a general rule, in the eastern portion the rainfall decreases with the latitude, though the decrease is slight on the immediate coast. On the Central Gulf coast, near Cape Hatteras and in northeast Georgia the annual rain fall exceeds 60 ins.; over the greater part of the Gulf and South Atlantic it exceeds 50 ins.; over the Middle Atlantic and New England coasts and the greater part of the Ohio Valley it exceeds 40 ins.; over the States east of the 97th meridian (excepting Minnesota) it exceeds 30 ins., and 20 ins. in the region east of the 100th meridian. The precipitation occurring within these regions is usually attendant upon the passage

of areas of barometric depression, and the extent and amount of rainfall depends largely upon the location and direction of movement of the centre of depression.

Barometric disturbances passing to the eastward, north of the region of observation, are usually attended by slight precipitation within the limits of the United States. But as the tracks of these depressions move to the south the rainfall attending them increases. Tropical storms passing over the southern and southeastern sections of the country may give monthly variations largely in excess of the normal of the month.

The western system of precipitation has its centre of greatest rainfall in the extreme northwest of Washington Territory, and falls rapidly as it goes south, from 105 ins. at Neah Bay to 10.18 ins. at San Diego. In this region the greatest rainfall is in the colder months of the year, and the amount and area increases with the decrease in temperature. The character of the season on the Pacific coast depends largely on the distribution of barometric pressures over the Pacific Ocean in a region outside of the field of observation. It is suggested that stations in Alaska and the Sandwich Islands would be of practical value in this connection.

The rainfall in the plateau region east of the mountain ranges on the Pacific coast is less than in any other section, rarely exceeding 10 ins. from Idaho to western Arizona. The mountain ranges on the coast arrest and precipitate the vapor on their summits and western slopes. But, says Capt. DUNWOODY, this reduction in the amount of vapor carried over is not sufficient to account for the reduced rainfall in this section. The annual precipitation over the arid region would not be increased one inch if all the rainfall of the Sierra Nevada range were distributed over the plateau.

The tables accompanying this report are useful to engineers and others in giving the comparative frequency of monthly and daily excessive precipitations for many important centres in the various groups of States. These tables also give the years of record, the elevation above the sea, the latitude and longitude and the monthly and total rainfall. Nearly 300 stations are covered. Noting some of these, we find Yuma, Arizona, maintaining its reputation for dryness with 3.11 ins. per year as the average or normal for 18 years. Hot Springs, Nev., 4,731 ft. elevation, has 3.56 ins. per year, and Wadsworth, Nev., 3.81 ins. New York City is credited with an 18-year normal rainfall of 43.82 ins.; Philadelphia with 40.51 ins.; Baltimore with 42.01 ins.; Washington, 43.43 ins.; Charleston, S. C., 57.19 ins.; Savannah, 52.63 ins.; Mobile, 62.92 ins.; New Orleans, 62.66 ins.; Galveston with 51.05 ins., etc. These normals are along the Atlantic and Gulf coasts; as shown before, they fall rapidly in amount as the location passes to the interior and westward.

Car Heating in Germany.

On almost all the main lines of the Prussian State Railways, the steam heating of railway cars has been introduced, and it is intended in time to use steam heating on the entire system. In addition to its cheapness and effectiveness, it has the advantage of being comparatively free from danger. The steam is supplied from the locomotive; it is forced through the pipes running underneath the carriages at a pressure up to two atmospheres, and leaves the train at its end, in so far as the steam has not been condensed into water in the meantime, in which case the water flows out through self-acting valves. In the first and second-class cars the temperature can be regulated by the passengers, while in the third class it is necessary to call the guard or other official when it is desired to alter the temperature.—*Kuhlow's German Trade Review.*

THE LATEST ADVICES from the Cañon are that Chief Engineer SANTON and his party of railroad surveyors reached the mouth of Diamond CREEK, on the Arizona line, on March 1. The trip through the Grand Cañon of the Colorado had been one of much danger and excitement, but had been, so far, successful in every way. A short stretch only of comparatively open river remains to be covered before the party emerges.

The Winner Bridge at Kansas City, Mo.

(WITH INSET.)

The very comprehensive and seemingly complicated inset illustration in this issue is the strain diagram and ordering sheet as actually used for one of the 283 ft. spans for the Winner Bridge now being built over the Missouri River, between Kansas City and the town of Harlem. The Chief Engineer and designer of this structure, Mr. FRANK D. MOORE, C. E., presents this plan to engineers as the outcome of an earnest effort on his part to avoid ambiguity in the division of stresses, and at the same time to reduce steel weights and shop work to a minimum. He also claims originality in the general design and details, in features which will make themselves apparent to any one who studies the plans presented; the reduction of counters to two in each truss is one of these features.

The bridge itself crosses the river about five-eighths of a mile above the present Hannibal & St. Joseph R. R. bridge. Including approaches the structure will be about 1⅛ miles long, commencing at the bluff in Kansas City, and ending with nearly one mile of trestle work on the opposite side of the river. The bridge proper is made up of four 428 ft. spans, two of 283 ft., and one of 150 ft. The general type of truss is shown in the illustration. The clearance below lower chord is 86 ft. at low water and 60 ft. at high water; in erecting it 8,500,000 lbs. of steel will be required by the Keystone Iron Works, which has the contract for the superstructure.

The substructure includes five pneumatic caisson piers and four piers founded without the use of compressed air. The stone used in these piers is Phœnix limestone, a very hard crystallized rock, up to the level of high water, and above this line "Strong City" limestone is employed. All face work is "dimension work," and a flemish bond is used throughout. The contract for the substructure is let to the Henry S. Hopkins Bridge Co., and includes about 12,000 cu. yds. of masonry.

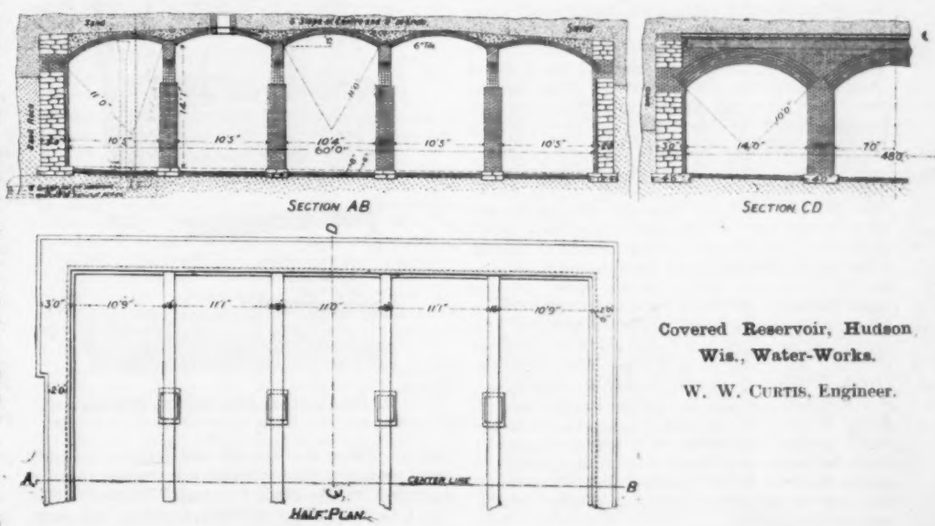
On March 1 the condition of the work was as follows: Pier 1, the excavation carried very nearly to bed-rock and the stone for the pier ready to ship at the quarry. Pier 2, foundation in bed-rock and 700 cu. yds. of masonry laid, extending 10 ft. above the water surface. Pier 3, the caisson is being put in place. Pier 4, caisson and crib now being sunk and nearly ready for masonry. Pier 5, the caisson is on the rock with 600 cu. yds. of masonry laid. This pier was sunk by sand pumps and wet blow-out process. Pier 6, caisson on rock with 650 cu. yds. of masonry laid; this foundation was sunk by locking and under air pressure. Pier 7, is in the rock 80 ft. below the surface and has 700 cu. yds. of masonry in place, reaching above the surface. Piers 8 and 9 are finished and the stone has been quarried for all the piers and is being shipped as fast as it can be used. This substructure work was commenced on Oct. 21, 1889, and as is shown it has been pushed at an exceedingly rapid pace, with three caissons under pressure at one time. If no unexpected delays occur the engineers expect "to do the quickest work of its class and magnitude" ever accomplished in the United States.

This structure is being built by the Kansas City Bridge & Terminal Railway Co., of which Mr. W. E. WINNER is the President. The purpose of the bridge is to provide a better crossing of the Missouri for railway trains approaching Kansas City from the north and northwest. At present the only means of access is by the bridge of the Hannibal & St. Joseph R.R., which is now used by five railways and is overcrowded. It is expected that at least four new lines and two lines at present entering the city will use the new bridge at a minimum rental for each road of $40,000 per year. Included in the same enterprise is a Belt Railway, 12 miles long, of which nearly one-half is completed. This terminal road will connect with every line of railroad now entering Kansas City, in addition to giving entrance to two lines now under construction.

Covered Reservoir, Hudson, Wis., Water-Works.

We are indebted to Mr. W. W. CURTIS, C. E., of St. Paul, Minn., for a blue-print and photographs of a covered reservoir designed by him, and constructed for the waterworks of Hudson, Wisconsin.

This reservoir has a capacity of 300,000 galls., and is entirely underground, being covered with 2 ft. of sand. The sections given show the general dimensions of the arches under the four longitudinal supporting spandrell walls. The sides of the reservoir are built of rubble masonry faced with brick; the piers, arches and spandrell walls are also of brick: while the flat covering arches of about 11 ft. span are made of 6-in. hollow tile, such as is used in floor and partition construction. The haunches of the covering arches are levelled up with concrete.



Covered Reservoir, Hudson Wis., Water-Works.

W. W. CURTIS, Engineer.

At the extreme left of "section *A B*" is shown a 6 in. overflow pipe connected with the vertical, funnel-capped overflow pipe given in dotted lines in the cut and extending to the maximum water-level in the reservoir.

This overflow extends past the foot of the vertical pipe, with a T-connection, and opens at the level of the reservoir floor, with a gate between the vertical pipe and the floor opening operated by a stem passing through the reservoir roof. As the concrete floor slopes toward this outlet, by opening the gate, the entire reservoir can be emptied and washed out through the 6-in pipe. The 12-in. inlet pipe comes in at the same end and opens at the floor level behind the vertical overflow, as shown in the cut. Both of these pipes are imbedded in concrete. The floor is made of concrete, from 6 to 8 in. thick, resting upon the sand-rock, from which the lower part of the reservoir is excavated.

Refinements of Modern Measurements.

At the tenth annual meeting of the Engineers' Society of Western Pennsylvania the address of the retiring president, Mr. J. A. BRASHEAR, was on the subject of "Refinements of Modern Measurements." Starting with the "arm of Henry I." and the ancient "barley-corn" standards, the speaker shows that many of our modern mechanics can measure to the one thirty-thousandths of an inch, though even the latter are coarse, rough measures when compared to others referred to later in the same paper.

For astronomical measurements the division of the meridian circle has been brought to astonishing accuracy. One of the most celebrated dividing engines for this purpose is that of the REPSOLDS in Hamburg. The maximum error of the best circles divided by this wonderful machine is 1.17 seconds. This engine is not automatic, but each line is set by from one to five microscopes and the division traced by hand. A more wonderful engine still is one made by Messrs. Fauth & Co., of Washington, D. C. This is entirely automatic, and a circle divided on this engine for the Cincinnati Observatory has a mean error of 1.0 seconds.

The astronomer at the Allegheny Observatory is not satisfied in his time measurements unless the error is reduced to within 3-100 of a second. Prof. S. P. LANGLEY'S occulting eye-piece shows the time of the occultation of a star to within one-twentieth of a second, and with experience this can be reduced to one-fiftieth of a second in a manner perfectly free from personal equation.

Mr. BRASHEAR then referred to the minute ruling on optical surfaces, used in the study of spectrum analysis, and in connection with which the name of the speaker is well known. When NOBERT, of Pomerania, produced his first diffraction grating, its entire ruled surface was but 2 centimetres square. To-day surfaces are produced 15 centimetres square, in which the error of curvature or flatness is reduced to less than one two hundred thousandth of an inch. And on these surfaces Prof. ROWLAND has ruled 110,000 lines with such precision that the error between any two lines is probably less than 1-3,000,000 of an inch.

Referring to the standards of weights and measures, Mr. BRASHEAR spoke of Prof. ALBERT MICHELSON'S refinement on the metre, taken as the one ten-millionth part of the earth's quadrant. Prof. MICHELSON has chosen a wave length of sodium light as the basis for a new standard—a something that will remain forever of the same absolute linear value, or as long at least as the solar system exists. This wave length is 5,890-10,000,000th of a millimetre, or about one forty-two-thousandths of an inch. As explained in a paper read before the Cleveland meeting of the American Association, this measurement can be made by a refractometre, and he showed that the error is not greater than one part in two millions, and possibly may not be greater than one part in ten millions. In making some of the optical surfaces for use with his refractometre an accuracy is demanded bordering closely on one-millionth of an inch.

Prof. WM. A. ROGERS, formerly of Harvard observatory, has devoted many years to the study of the errors in standards in use in this country and in Europe. Among other important facts he has proved that the expansion of metals is equal for each degree within a range from zero to the boiling point. Prof. ROGERS has also had a screw made under his supervision, with a linear error not greater than 0.00005 of an inch. It cost the labor of two of the best workmen at the Waltham Watch factory 425 hours of time at $1.00 per hour; so that it cost almost half its weight in gold. This screw, however, has a periodic error of "drunkenness" which makes it useless for the purpose intended.

In electrical science the ammeters, voltmeters and galvanometers measure currents as low as one hundred millionth of an ampère. With the bolometer, depending for its action on a feeble electric current and used to register forms of energy coming to the earth from the sun, a deflection of one milimeter on the galvanometer scale is registered by a current of five-billionth of an ampère through coils of 20 ohms resistance. By using an observing telescope on the divided scale, one-tenth of this deflection can be readily determined; and if this is put in temperature coefficients, one-billionth of a degree centigrade can be indicated and one-millionth of a degree be measured.

In speaking of the refinements in the work of the civil engineer, the speaker noted a recent triangulation in Southern California, 11 miles in extent, in which the mean error of three sets of observations was less than *one centimetre*, or 0.3937 in. These observations were made under the direction of Prof. GEORGE DAVIDSON, who represented this country at the late Paris Congress of Engineers.

In the realms of the higher sciences the mind of man, says Mr. BRASHEAR, has reached, as it would seem, almost to the infinite. Sir WM. THOMPSON has estimated the molecule to be somewhere between one two-hundred-and-fifty-millionth of an inch and one five-billionth of an inch. As he says, "if a drop of water were magnified to the diameter of the earth, and the molecules magnified in the same proportion, the smallest as noted would be coarser grained than a heap of small shot and the largest less in diameter than a heap of cricket balls." Prof. ROOD has shown that a flash of light lasting but forty billionths of a second, is capable of making an impression on the human retina; and Prof. LANGLEY has shown that the human eye has a vast range in the intensities of lights it can perceive, represented by the ratio of 1 to 1,000,000,000,000,000. Prof. NICHOL has also shown that the human eye can detect one part of coloring matter in one hundred million parts of white.

Gradient Indicator for Drains.

In a late issue of *Industries* a neat and simple device is shown for laying drain pipe to fixed grades. As shown in the cut, special blocks are made for various grades, with the angle between the top and

A Gradient Indicator for Drains.

bottom fixing the rate of inclination. A spirit level applied to the horizontal side enables the pipe to be laid to the grade required. The inventor is Mr. I. C. WALLAS, of Kilburn, London. The same device can readily be used for testing the gradient of a line of drain already in place.

One of the Dangers in Excavating Sand.

Herr SCHILLING has described a rather unusual accident in a recent number of the *Centralblatt der Bauverwaltung*, an account of which may be of interest to engineers engaged in sand excavation. During the construction of the Neustrelitz & Warnmund Ry. the line of the road crossed, near Laage, the Recknitz, a small stream about 16.5 ft. wide and 5 ft. deep. The line is carried over this river on an arch. The upper stratum of soil is a dense peat, 16 ft. thick. Under this is a stratum of very fine sand, upon which the foundation courses are laid. The two excavations for the abutments were made by driving sheet piles about the places where the digging was to commence, and then removing the material in the usual manner. The bed of the Recknitz was not altered in any way. The spaces so inclosed were about 28 ft. by 13 ft. each. The piles were driven 5 ft. into the sand. There was no difficulty in removing the first 10 ft., but at that depth it became necessary to start a double suction and force pump at each side of the river. In this way about 3.3 ft. more were easily removed. In order to take out the remaining 3 ft., all the available pumps—three double and two smaller single ones—were started at one of the excavations. All this was in vain, however, and it was decided to lay a beton bed on the small stratum of peat remaining.

Meanwhile in the other trench, 50 ft. from the first, all the peat had been removed and the masons were beginning to put in the foundations, when the ground seemed to rise suddenly from under their feet. An immense volume of water rushed upward, and the laborers barely escaped.

An immediate investigation showed the surprising fact that the trench had been half filled, not from the river, but from the excavation on the other side of the Recknitz. Before the accident, the water in the latter was on a level with that of the Recknitz, afterward, it was 6.5 ft. lower and the other trench now contained just the amount that had escaped. Only after several hours was the level in both the same as that of the river.

Although this occurrence was perfectly natural the two excavations being connected by the sand, nevertheless it was entirely unexpected. Thick peat is a good material for puddling, and the sheet-piling was carefully driven. All reasonable precautions had been taken against any penetration of water through the sides of the cut. After this costly experience there was no more desire to put in dry foundations, and beton beds were laid in both places.

The 453 ft. Chimney at Halsbrucke, Saxony.

This chimney is being built at the Imperial Foundry of Halsbrucke, near Freiburg, Saxony, with the object of delivering the objectionable gases from the furnaces at such a height that they will cease to be a nuisance to the neighborhood. Its height will be 452.6 ft. and its inside diameter 15.7 ft. It was designed by Engineer HUPPNER, and will be erected upon the right bank of the Mulde at such a level that the top of the chimney will be 712 ft. above the river level.

The base will be 39.4 ft. square and 28½ ft. high. The chimney proper will be circular and built of brick. The works are removed about 3,227 ft. from the chimney and across the river, and it will be necessary to connect them by a masonry conduit, crossing a bridge. The total cost of the chimney is estimated at $30,000, but the connecting work will double this sum.

Tests of the Transverse Strength of Aluminum.

In the paper on "The Properties of Aluminum," published in our issue of Feb. 22 and March 1, no data were given as to the tests of the transverse strength of aluminum. The authors have recently made such tests, results of which are given in the following table. The metal tested was the "average lot" metal made by the Pittsburg Reduction Co., and containing 98.52 per cent. of aluminum and other elements as given on page 184 of our issue of Feb. 22.

TEST NO. 1.

Round bar, 1¼-ins. diameter, supported on knife edges 12 ins. apart, and loaded at center with single load.

Load.	Deflection.	Permanent Set.	Load.	Deflection.	Permanent Set.
100	0	.....	1,500	4-64	1-64
200	0	.....	1,600	6-64	.....
300	0	.....	1,700	6-64	.....
400	0	.....	1,800	6-64	.....
500	0	.....	1 900	8-64	.....
600	0	.....	2,000	10-64	7-64
700	0	.....	2,100	13-64	.....
800	1-64	.....	2,200	14-64	.....
900	1-64	.....	2,300	17-64	.....
1,000	2-64	0	2,400	20,64	.....
1,100	2-64	.....	2,500	26,64	.....
1,200	2-64	.....	2,600	31-64	.....
1,300	3-64	.....	2,700	36-64	.....
1,400	3-64	.....	2,800	43-64	Broke.

TEST NO. 2.

Bar 1 in. square, supported on knife edges 24 ins. apart; loaded at centre with single load.

Load.	Deflection.	Permanent Set.	Load.	Deflection.	Permanent Set.
50	3-64	2-64	225	63-64	.....
100	5-64	.....	250	1 24-64	1 16-64
150	23-64	18-64	275	1 60-64	1 50-64
175	29 64	.....	300	2 13-64	2 2 64 & not ruptured.
200	47-64	40-64			

In regard to these tests Mr. A. E. Hunt writes: They show that the metal has a very low elastic limit. The ordinary specifications for cast iron are that a bar 1 in. square supported on knife edges 4 ft. 6 ins. between centres shall carry a load of 500 lbs.

without rupture and a deflection of more than 2 ins.

An attempt was made to apply the formula for deflection

$$D = \frac{P l^3}{48 E I}$$

[In which D = deflection in inches, P = centre load in lbs., l = span in ft., E = the modulus of elasticity, pan I = the moment of inertia of the cross-section,] reckoning the modulus of elasticity at about 10,000,000, but without success. In fact, there seemed to be in the two sets of tests no constant to replace the 48, or no valuation for the E, modulus of elasticity, which would give satisfactory results and conform to the deflections obtained by the specifications.

PERSONALS.

Mr. JOHN O'DAY, Vice-President of the St. Louis & San Francisco R. R. Co., has resigned.

Mr. E. HAWLEY has been appointed Assistant General Traffic Manager of the Southern Pacific R. R.

JOHN WILEY & SONS, publishers of engineering and scientific works, have moved to 53 East 10th St., New York.

Mr. W. H. GREEN, General Superintendent of the Richmond & Danville R. R., has been appointed Assistant General Manager.

Mr. WARREN G. ELLIOTT has been elected President of the Wilmington & Weldon R. R. Co., with office at Wilmington, N. C.

Mr. E. A. POTTER has been appointed Division Engineer of the Wisconsin and Milwaukee Division of the Chicago & Northwestern Ry.

Mr. D. S. CLEW has been elected Treasurer of the Gloucester Iron Works, 401 Chesnut St., Philadelphia. Pa., vice Mr. HENRY B. CLEW.

Col. S. H. LOCKETT, C. E., has returned to Carthegena, U. S. of Colombia, on work connected with railways and harbor extension in that section.

Mr. HENRY M. KINGSTON has been appointed General Manager of the Pennsylvania, Poughkeepsie & Boston R. R., vice Mr. J. C. STANTON, resigned.

Hon. WARNER MILLER has been elected President of the Nicaragua Canal Construction Co., vice Mr. A. C. CHENEY. Mr. CHENEY is now Vice-President.

Mr. ROBERT BAXTER has been appointed Superintendent of the Wyoming division of the Union Pacific R. R., vice Mr. W. L. REYDER, transferred to the Idaho division.

Mr. EDWARD D. BOLTON, C. E., of 44 Broadway, New York City, has been appointed Consulting Engineer on the construction of the new sewerage system at Tarrytown, N. Y.

Mr. S. L. MARSDEN, of the Farrel Foundry & Machine Co., Ansonia, Conn., died at New Haven, March 3. He had made a number of improvements in the Blake and Farrel & Marsden rock crushers manufactured by this firm.

Mr. A. GRIGGS having resigned his position as Master Mechanic of the Worcester devision of the New York, Providence & Boston R. R., the jurisdiction of Mr. L. M. BUTLER, Master Mechanic of the Providence division, has been extended over the whole line.

Mr. GEORGE HACKNEY having resigned the position of Superintendent of Machinery on the Atchison, Topeka & Santa Fe R. R., east of the Missouri River, the jurisdiction of Mr HARVEY MIDDLETON, Superintendent of Machinery west of the Missouri River, has been extended to cover the Chicago line.

Mr. T. H. BOORMAN has resigned from his position in the New York Controller's Office to accept a responsible position with the Sicilian Asphalt Paving Co., HOWARD CARROLL, President. Mr. BOORMAN has been an asphalt expert in the New York Department of Public Works and in the Department of Parks.

Mr. C. M. BENNETT, Superintendent of the eastern division of the Chicago, St. Louis & Pittsburg R. R., which extends from Indianapolis to Columbus, is to succeed Mr. CHARLES WATTS as Superintendent of the Chicago division. Mr. F. G. DARLINGTON, Superintendent of the Cincinnati & Muskingum Valley R. R., will succeed Mr. BENNETT on this division.

MR. CARL BINDER and Mr. MAURICE SEIFERT have formed a partnership as contractors and consulting engineers under the firm name of Binder & Seifert. Their office is at 169 Jackson St., Chicago, Ill. Mr. SEIFERT has been a member of the firm of Gottlieb & Co. for the last five years. Mr. BINDER has been Bridge Engineer of the Lake Shore & Michigan Southern Ry. till last Spring, when he opened an office as consulting engineer in Chicago. They are prepared to make designs and estimates, to superintend and to contract for all kinds of bridges, roofs, buildings and foundations.

PUBLICATIONS RECEIVED.

—Third Annual Report of the Interstate Commerce Commission. 6x9 ins., cloth bound. 463 pp. Copies may probably be obtained by addressing EDWARD A. MOSELEY, Secretary to the Commission.

The advance sheets of the volume were fully reviewed and abstracted in our issues of Jan. 11 and 18. The appendices to the report proper give a list of the employés of the commission; the circulars issued during the year; a brief summary of the points decided by the commission during the year; dispositions made of the complaints made to the commission during the year; a statement of the important points decided by the commission since its organization; report of an investigation of methods of keeping freight accounts; copy of circular sent by the commission to the Government—aided telegraph lines; description of locality covered by each one of the existing freight classifications; list of the important Canadian railways with information as to their routes, mileage, rates, etc.; list of State railroads claiming not to be subject to the Interstate Commerce Act; data from State Railroad Commissions, prominent railway officers and others regarding the Federal regulation of safety appliances; data as to the relations existing between railway corporations and employés on 85 principal railways; data as to railways in various foreign countries collected by the Department of State, and finally the act to regulate commerce as amended and approved.

—Seventh Annual Report of the Kansas Railroad Commission, for the year ending Dec. 1, 1889. ALBERT R. GREENE, JAS. HUMPHREY, GEO. T. ANTHONY, *Commissioners.* 6x9 ins., cloth bound, 517 pp.

This report shows that there are over 8,800 miles in operation in the State. The average capitalization per mile is $52,155. The gross earnings and income for the year ending June 30, 1889, were $10,915 per mile. The operating expenses were $6,608 per mile; and the fixed charges (interest on bonds, taxes, etc.,) were $4,222 per mile, leaving a margin of $85 per mile available for the payment of dividends.

—Fourth Annual Report of the Water Commissioners to the Common Council of the City of Schenectady for the Year ending Nov. 1, 1889. Pamphlet, 22 pp. GEO. T. INGERSOLL, Superintendent; E. C. ANGLE, Secretary.

Quite a range of pumping statistics are given, but the record is not complete for some of the months, and no attempt is made to show the cost per gallon pumped.

—Tenth Annual Report of the State Board of Health of Illinois. Pamphlet, 5½ × 8¾ ins., 313 pp. Springfield, Ill., 1890. JNO. H. RAUCH, Secretary.

This report is for the year 1887, the delay being caused by complications in the State printing contract. An interesting feature of the report is an Official Register of Physicians and Midwives, corrected to Jan. 1, 1890. At that date there were in Illinois 6,215 persons practicing medicine, of whom 5,640 were graduates and licentiates and 575 non-graduates. The law regulating the practice of medicine went into effect July 1, 1877, when there were in the State 7,400 calling themselves doctors, of whom 3,800 were non-graduates, or, in other words, had nothing to show entitling them to practice medicine.

—Report of Committee on Water Supply of the Town of Southborough, Feb., 1890. Pamphlet, 20 pp. FRANK L. FULLER, Engineer to Committee.

Abstracts from the report and further information regarding the project will be found in our news columns in this and future issues.

—Report on the Section of Steam Transportation, U. S. National Museum. J. E. WATKINS, Hon. Curator, Sect. Transportation. Pub. Doc. Pamph.

In Preparation.—*The Washington Bridge over Harlem River at 181st St., New York City.* With a description of its construction by WILLIAM R. HUTTON, Chief Engineer. With 24 double and single page photo-gravure plates, and 24 double-page lithographs and other engravings. Large quarto, 75 pp. text. Published by LEO VON ROSENBERG, 35 Broadway, New York. Price $5. Orders now received.

From advance sheets and illustrations seen by us, we can state that this will be an interesting and valuable history of this structure, known also under the names of the Harlem and Manhattan Bridge. The subject matter will cover the history of the bridge from its inception; a description of the pneumatic caisson foundation; plans and description of the masonry and iron work; strain sheets, etc. The illustrations from photographs are admirably done.

—Bulletin of the North Carolina Board of Health. February, 1890. Pamphlet.

—Journal of the Franklin Institute.—Philadelphia, Pa., March. 1890.

This number contains papers on "Emery Wheels," T. Dunkin Paret; "Schools, with particular reference to Trades Schools." Also a report on the "Ives Portable Projecting Lantern."

—Strains in Curved Masonry Dams. By HUBERT VISCHER and LUTHER WAGONER. A paper read before the Technical Society of the Pacific Coast, Nov. 1, 1889. Pamph. pp. 77, 4 folding plates.

A valuable and elaborate discussion of the theory of this vexed question, which we have briefly referred to editorially, and which we shall hope to review more at length in a later issue. The paper has reference more particularly to the facts of the Bear Valley dam, the boldest curved dam in the world, and we advise every one interested in the theory of the subject to obtain a copy of it.

—An Improved System in the Construction of Railway Cars. By MAX A. ZURCHER, C. and M. E., Ass't Engr Can. Pac. Ry.

A proposed system of wholly metall c car construction claiming to reduce dead weight from 15 to 22 per cent., with greater strength and less cost per ton of carrying capacity. The car body is made a skeleton tube of truss work. The inventor is a civil engineer of long standing and an old designer of iron work. Whether he has grasped all the special necessities of car construction we cannot now undertake to say.

—Canals and their Economic Relation to Transportation. By Prof. LEWIS M. HAUPT, A. M., C. E., Univ. Penna., Philadelphia, Pa. Paper before the American Economic Association, pp. 27.

A plea for the enlargement to a modern ship canal basis of the Delaware & Raritan and Delaware & Chesapeake canals; and a forcible and weighty one, replete with facts

—Analysis of Mechanical Filter Actions.—A paper read at the Louisville meeting of the American Water Works' Association. Pamphlet, 12 pp.; illustrated.

The filters described are the Hyatt, National, Oliphant Roeske, Warren, American, Crocker, Jewell and West.

TRADE PUBLICATIONS.

—Automatic Brakes and Couplers.—Progress made in the Equipment of Freight Cars. Issued by the Westinghouse Air Brake Co., Pittsburg, Pa. Pamphlet, pp. 24, with colored maps and tables.

This is a reprint in very handsome and tasteful form o the matter in relation to the introduction of automatic brakes and couplers, and the money value of good brakes and couplers, which appeared in ENGINEERING NEWS of Dec. 21, 1889. The reprint is without note or comment, as it originally appeared, leaving the matter to speak for itself, as it is able to do quite eloquently.

—The Thomson Water Meter.—Illustrated description with details and price list. Size, 9¼ × 11¾ ins., 56 pp. The Water-Waste Prevention Co., New York.

This pamphlet contains an interesting description of this meter and its action. A chamber having a known capacity is successively filled and displaced, the mechanism being operated by the water which it measures. Up to Jan., 1890, over 5,500 had been sold.

—Properties and Tables of Steel Beams.—Compiled by F. H. Kindl, C. E., from Carnegie, Phipps & Co.'s "Pocket Companion," 1890.

SOCIETY PROCEEDINGS.

Engineers' Club of Philadelphia.—Record of regular meeting, March 1st, 1890, President H. W. Spangler in the chair; 16 members and 2 visitors present. The Secretary presented, for Mr. Howard Constable, an illustrated paper on the "Re-enforcement or Under-pinning of the Iron Piles of a Draw-bridge Pier." Mr. Barton H. Coffey presented a paper "On the Purifying Effect of Sand Filtration." There was some discussion. Mr. Howard Murphy expressed the opinion that some day we would have to adopt a separate system of water supply, furnishing the very small quantity of water required for strictly personal, domestic and similar uses, from pure sources, and the immense quantities required for manufacturing and general uses for sources not capable of yielding potable water. Mr. Henry G. Morris described a new method of sinking dies, exhibiting a beautiful specimen of the results accomplished. He stated that a result could be obtained by this process at a cost entirely insignificant when compared with cost by the old method.

HOWARD MURPHY, Secretary and Treasurer.

Engineers' Club of St. Louis.—At the meeting on March 5, President Nipher in the chair, Mr. Willard Beahan read a paper on "American and Foreign Railways." This paper was a report of a recent trip he had made, and gave the results of his observations of the countries passed through, with particular reference to their railways. Mr. Beahan's observations extended to Panama, a number of countries in South America, France, England, Scotland and Ireland. Some description was given of the topography of the countries traversed, from the point of view of a railway locating engineer. The road beds of the railways were described, together with their ties, rails, ballast, grades, curves and bridges. Some information was also given as to the locomotives used, and the rolling stock, speed and the class and nationality of men employed to operate the roads. Comparisons were made between American and foreign railways on the points of original cost, maintenance and operation, showing wherein American roads excelled and wherein they might learn something. The iron ties used in South America were described. A brief description was also given of the Forth Bridge.

Mr. Moore stated that lignum-vitæ ties were being used successfully in Mexico. Their cost was about $1 each, and they lasted indefinitely. WM. H. BRYAN, Secretary.

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D. McN. STAUFFER A. M. WELLINGTON
EDITORS.
CHAS. W. BAKER E. E. R. TRATMAN M. N. BAKER
ASSOCIATE EDITORS.
GEO. H. FROST.....BUSINESS MANAGER

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Advertising rates. 20 cents per line *agate measure. Schedule sent on request.* **Changes** *of advertisements must be in hand on Tuesday afternoon:* **New** *advertisements Wednesday afternoon;* **Transient** *advertisements not later than Thursday noon. The last pages go to press early on Friday, and we will be obliged if parties who fail to receive their papers promptly will notify us without delay.*

Drawings and Photographs *of all new engineering works or designs, large or small, of interest from their magnitude, novelty, or originality, as well as newly adopted* **Standard Plans** *for engineering structures or details, rolling stock, etc., are always desired for early publication. Also* **Brief Technical Notes** *of the cost or manner of executing work, tests of materials, machines or other new devices, and* **News of New Construction** *of all kinds.* **Letters** *for publication must be accompanied by the name or card of the writer.*

COMING TECHNICAL MEETINGS.

Engineers' Club of Philadelphia, Pa.—Next meeting March 15. Secy., Howard Murphy, 1122 Girard St.

Western Railway Club, Chicago, Ill.—Next meeting, March 18, Rooms in the Phœnix Building. Secy., W. D. Crosman.

Engineers' Society of Western Pennsylvania.—Next meeting, March 18. Secy., S. M. Wickersham, Pittsburg, Pa.

Boston Society of Civil Engineers.—Annual meeting, March 19. Secy., S. E. Tinkham, City Hall.

Engineers' Club of St. Louis, Mo.—Next meeting, March 19. "A National Federation of Engineering Societies." Prof. J. B. Johnson. Secy., W. H. Bryan, 309 So. 7th St.

American Society of Civil Engineers, New York.—Next meeting, March 19. Secy., John Bogart, 127 E. 23d St.

Civil Engineering Society (Mass. Inst. of Technology), Boston, Mass.—Next meeting, March 20. Secy., Clement March.

New York Railway Club.—Next meeting, March 20. Rooms at 113 Liberty St.

Western Society of Engineers, Chicago, Ill.—Next meeting, April 2. Secy., J. W. Weston, 230 La Salle St.

Engineers' Club of Kansas City, Mo.—Next meeting, April 7. "Bridge Foundations in the Kansas River." E. I. Farnsworth. Secy., Kenneth Allen, 200 Baird Building.

Civil Engineers' Society, St. Paul, Minn.—Next meeting, April 7. Secy., Geo. L. Wilson, City Hall.

Civil Engineers' Club, Cleveland, O.—Next meeting, April 8. Secy., C. O. Palmer, 22 Cedar Ave.

Civil Engineers' Association of Kansas, Wichita, Kan.—Next meeting, April 9. Secy., J. C. Herring, Wichita.

New England Railway Club, Boston Mass.—Next meeting, April 9. Secy., F. M. Curtis, Old Colony R. R. Rooms in the United States Hotel.

Engineering Association of the Southwest, Nashville, Tenn.—Next meeting, April 10. Secy., Olin H. Landreth, Vanderbilt University.

IN our last issue the article on the Colorado Cañon survey was sent down to the printers so late that the "revise" was not seen by the writer. Thanks to the Editor's bad MS., the name of Mr. F. A. NIMS was printed "F. A. NEVINS" throughout. Our readers will please correct accordingly.

THE discussion of the question of curved vs. straight dams, which began in this journal in January, 1888, has borne fruit in many papers and discussions since, with the obvious tendency, as it has seemed to us, of bringing the curved form into greater favor, as showing that it has always certain decided advantages, often very great advantages, and never any sensible disadvantages, even in the matter of comparative volume and cost, which seems at first sight clearly against it, since a curved line is always longer than a straight one between the same points. The latest evidence of this tendency is an elaborate paper by Messrs. HUBERT VISCHER and LUTHER WAGONER, recently read before the Technical Society of the Pacific Coast, which has just reached us, in which the theory of "Strains in Curved Masonry Dams" is very elaborately investigated from many points of view, with especial reference to the Bear Valley dam, the boldest arch dam in the world, which continues to confound prophecy, like the Zola dam, by doing its work with apparent ease and without sign of deterioration.

As we hope to review the theoretical part of this work (with all of which we can hardly agree) on some later occasion, we confine ourselves now to stating its main conclusion; that the curved form always has an advantage of real importance over the straight one, which is not so much dependent on short radius as is supposed, but which, on the other hand, may easily be overrated, as we also have repeatedly said. With the conclusions we have no quarrel, nor are we even yet prepared to say that we shall be compelled to question some of the methods of reaching these conclusions, although our present impression is that we shall have to do so.

As to the alleged greater simplicity of the strains in a straight dam the authors point out very cogently that this is more imaginary than real, and on the vital question of comparative quantities express in the following pithy words what they find to be the facts:

> As regards the extra amount of masonry required by the use of a curved plan, it is generally a very small quantity; much less than has been frequently assumed. Upon this point we speak advisedly, and after having had occasion to test the statement in connection with a number of dam sites. The difference is not usually 10 or 15 per cent., as has been suggested; 5 per cent. in almost any practical case allowing for very liberal curvature, probably quite up to what would appear desirable in practice, with due regard to securing suitable abutting angles between the arch and the cañon walls.
>
> For the Bear Valley dam, the quantity of masonry in the present dam (not including the lower base), as nearly as can be estimated from the plans, is about 2,019 cu. yds. Had the dam been straight, the quantity would have been 1,986 cu. yds. A straight dam of equal height, constructed upon recognized principles (excluding tensile strains in the dam), would have required about 4,860 cu. yds. The use of curvature in the actual dam only increased the amount of masonry about 1⅗ per cent., and the dam as constructed only consumed 41¼ per cent. of the masonry which an orthodox "gravity" project would have required.
>
> The most pronounced opponent to the use of curvature would hardly assert that a straight dam, of the same cross-section as the Bear Valley dam, would have successfully resisted the load which a full reservoir would have subjected it to; and whatever the opinion as to the boldness of the design, its performance must be recognized, and its efficiency conceded as a result of the use of curvature, under conditions which entailed but slight additional cost.

A NEW and higher dam is shortly to be constructed below the bold Bear Valley arched dam, in such manner that the existing structure will be gradually relieved of the heavy arch strains which it is now sustaining. This affords a unique opportunity to make some careful observations of the actual yielding of that dam under strain which will not only shed great light on the actual behavior of curved dams under strains but afford needed light as to what is the real modulus of elasticity of masonry. The authors of the paper referred to above call special attention to this fact, and urge that the opportunity shall be duly improved. We heartily join them in the suggestion. The world is not likely to see for some time to come so bold an arch dam as the Bear Valley; it can be rarely warrantable that so bold a one should be built; and it is still more unlikely that a new dam will ever again be required just below such a dam, while the latter is still intact, and so near to it that it will cost but little water and no money to repeatedly load and unload this dam with its full water pressure, so that its exact elastic yielding under strain can be observed. If there be only some one on the ground able and willing to make the proper precise observations, as we have every reason to believe there will be, data of the highest value as to the elastic action of masonry, not only for curved dams, but for all other large masonry structures, may be collected.

OUR esteemed contemporary, *The Engineer*, in referring to the project for a competitive trial of English and American limited express engines, to which we referred in our issue of Feb. 8, remarks:

> We are sorry to add that an esteemed contemporary, the ENGINEERING NEWS, has taken offense at what we recently said on the subject. Unfortunately, in speaking of the American flag, we spoke of the stars and bars, instead of the stars and stripes. *We confess that we fail to comprehend the nature of our offense,* but we meant no offense to the American flag, and we trust that our contemporary will accept this statement as a sufficient apology.

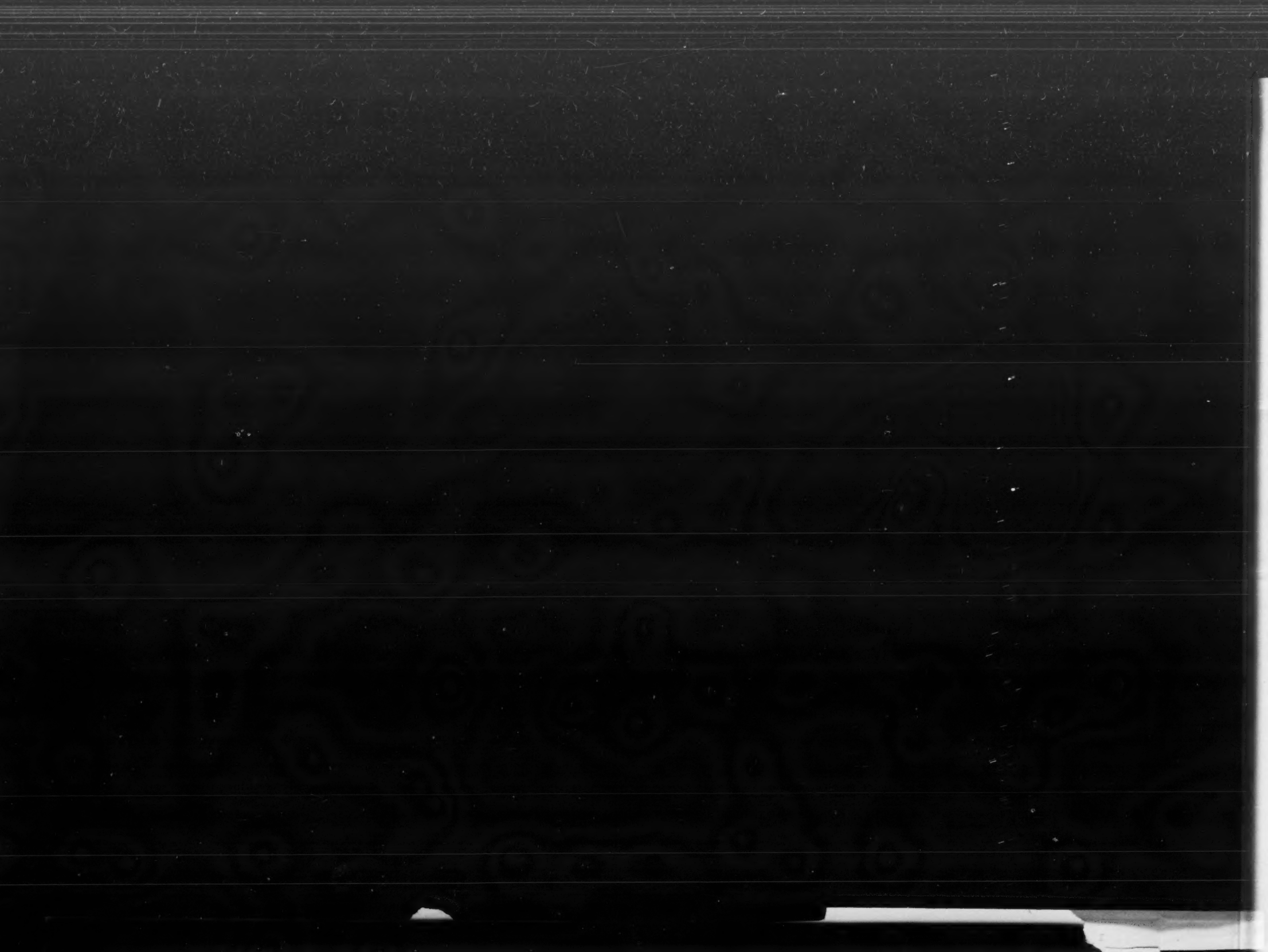
We do, Esteemed Contemporary, we do; for there was "no offense, not the least in the world," as our mutual friend HAMLET remarks; but as the nature of the error (not offense) is even yet not understood, and as a knowledge of history is sometimes convenient even to the technical editor, we will explain that in the remote past of 1861 there was a war begun on this continent which continued until 1865, and was at the time a somewhat notorious unpleasantness even on the other side of the ocean.

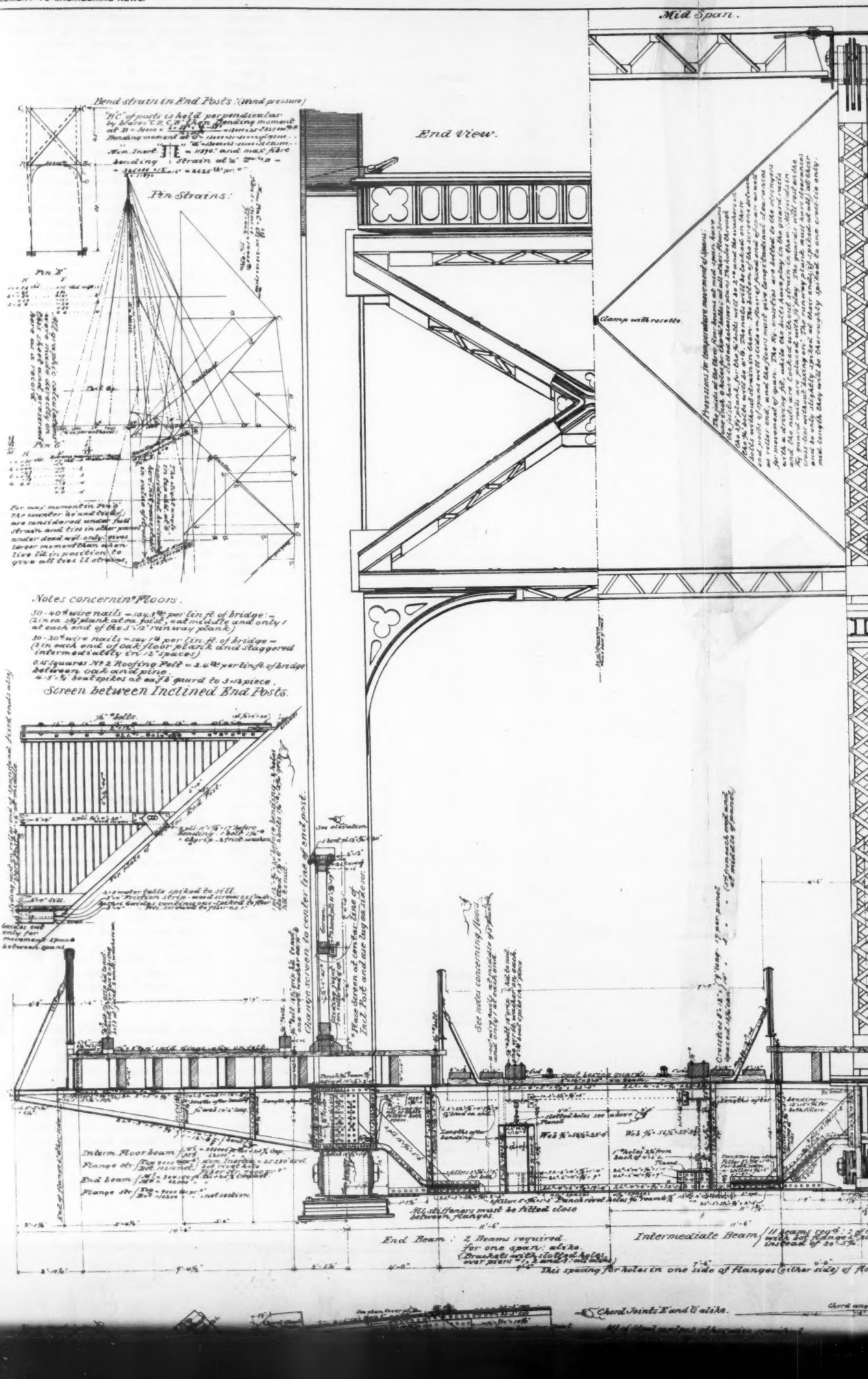
The successful side in this armed discussion, then and since known as the United States, had a flag called the Stars and Stripes, consisting of a blue star-spangled field and thirteen red and white *stripes*, while the defeated side had a similar star-spangled field and only three red and white *bars* instead of the stripes, whence it was popularly known as the Stars and Bars. The Stars and Bars were much more popular in England about then than the Stars and Stripes, which doubtless explains how the phrase has been impressed most forcibly on our contemporary's mind; but as we tried to hint by an allusion to the "golden harp of England's banner," such confusion about two fairly well known emblems seems to an American somewhat amusing. We trust this more explicit explanation will make the matter clear at last.

THE *Engineer* proceeds:

> We can scarcely regret the mistake, if it deserves the name [it does, contemporary], because it has induced our contemporary, no doubt in the heat of the moment, to make certain statements about railway work in the United States which are interesting, and even partake of the nature of admissions which are, in a sense, new to us.

Our contemporary then proceeds to republish the technical part of our note in full, and to discuss it at considerable length, in the course of which it throws out a challenge when it remarks that: "Possibly the ENGINEERING NEWS may see fit to take up, and instead of dealing with vague assertion, explain precisely in what way and how the American engine is a better all-around machine than ours." This is a fair proposition (which is more than we can say for certain propositions which the *Engineer* manages to twist our words into), and as it does not block out a task which we feel to be beyond us, but on the contrary, one which we feel quite equal to, we shall endeavor in a later issue to show by facts and figures that the American engine is pre-

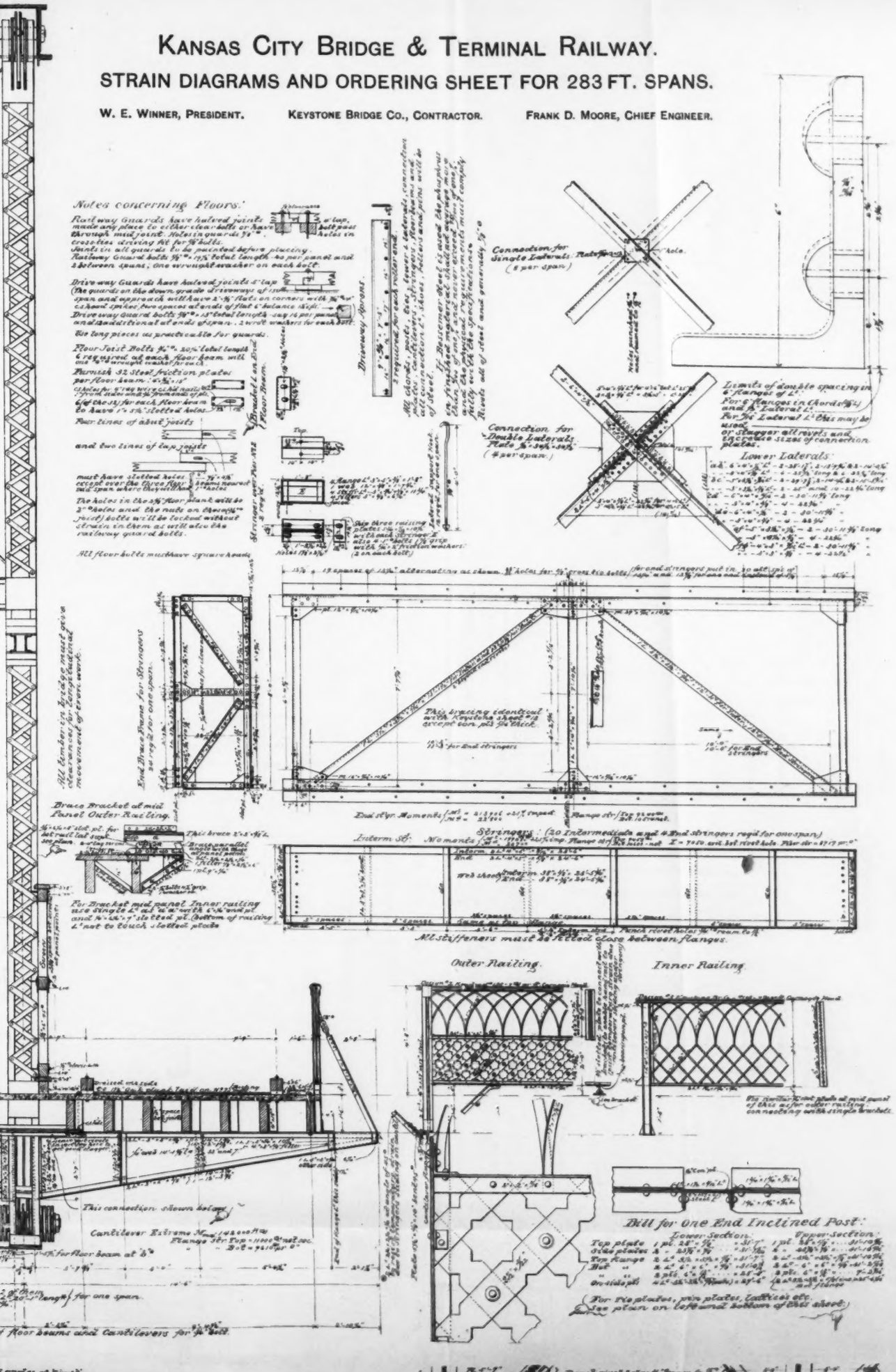


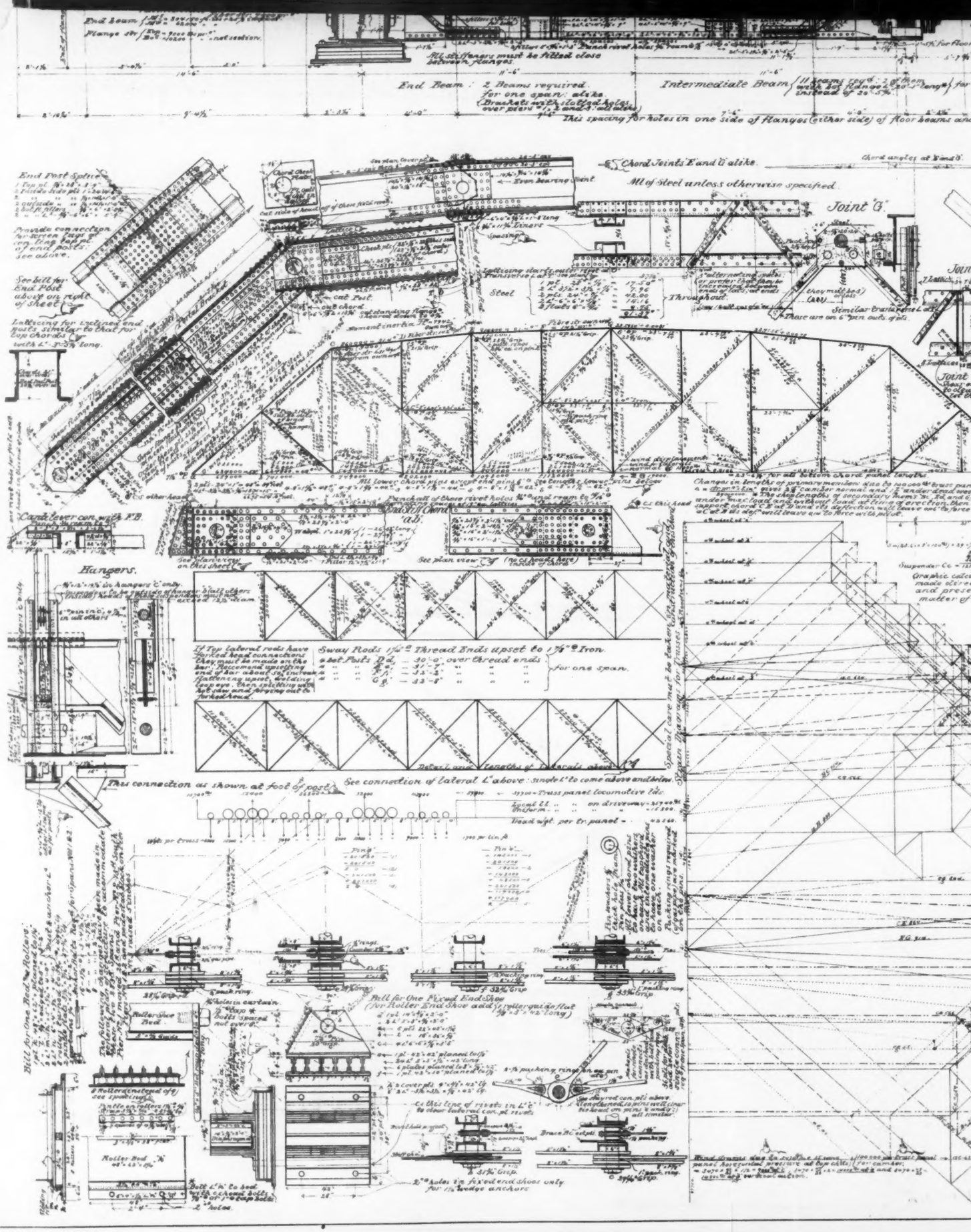

Mid Span.
End View.
Bend strain in End Posts (Wind pressure)
Pin Strains.
Notes concerning Floors.
Screen between Inclined End Posts.
Change screen to center line of end post.
See notes concerning floors
Intermediate Beam
End Beam: 2 Beams required for one span: alike.
Chord Joints E and E' alike.

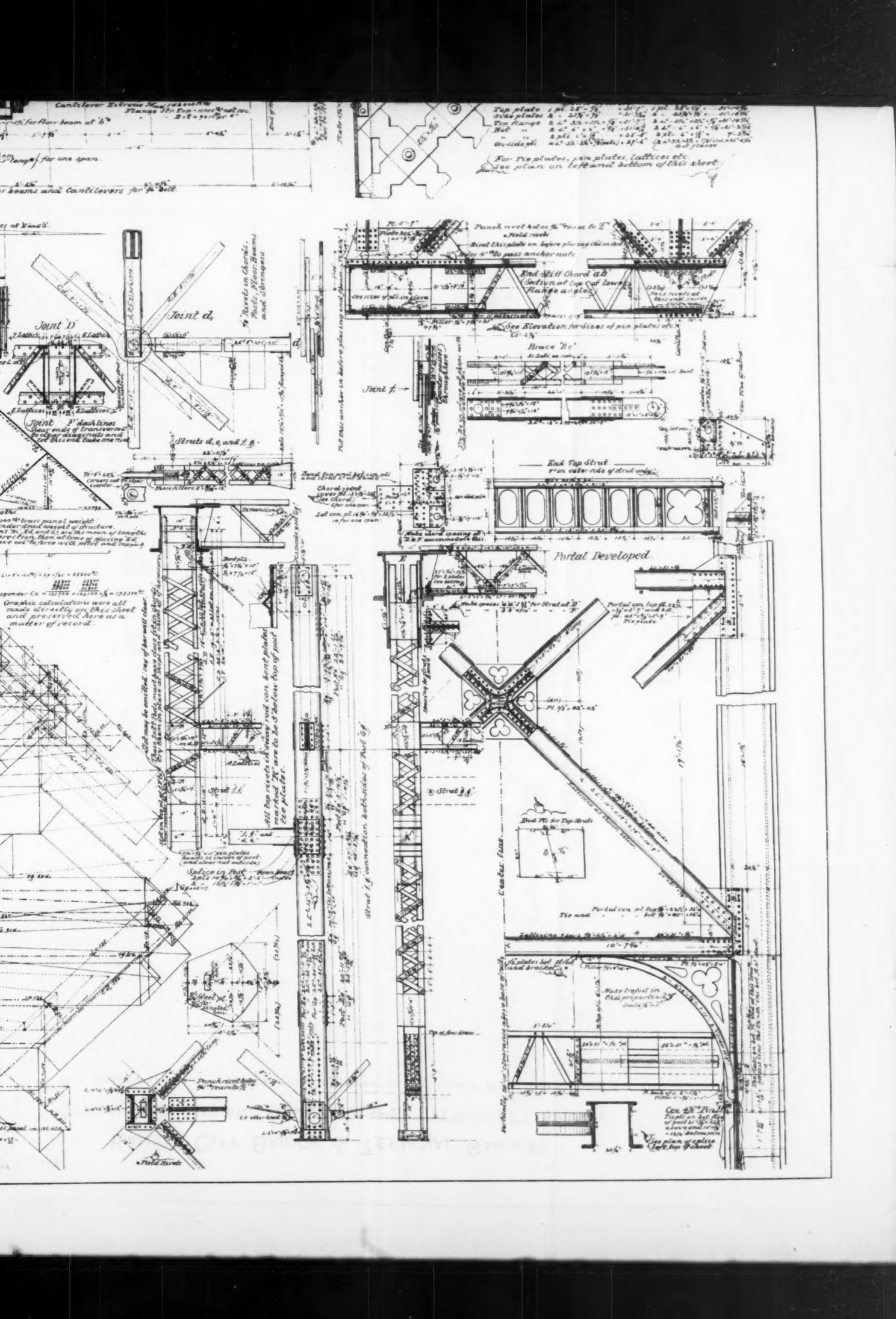
KANSAS CITY BRIDGE & TERMINAL RAILWAY.

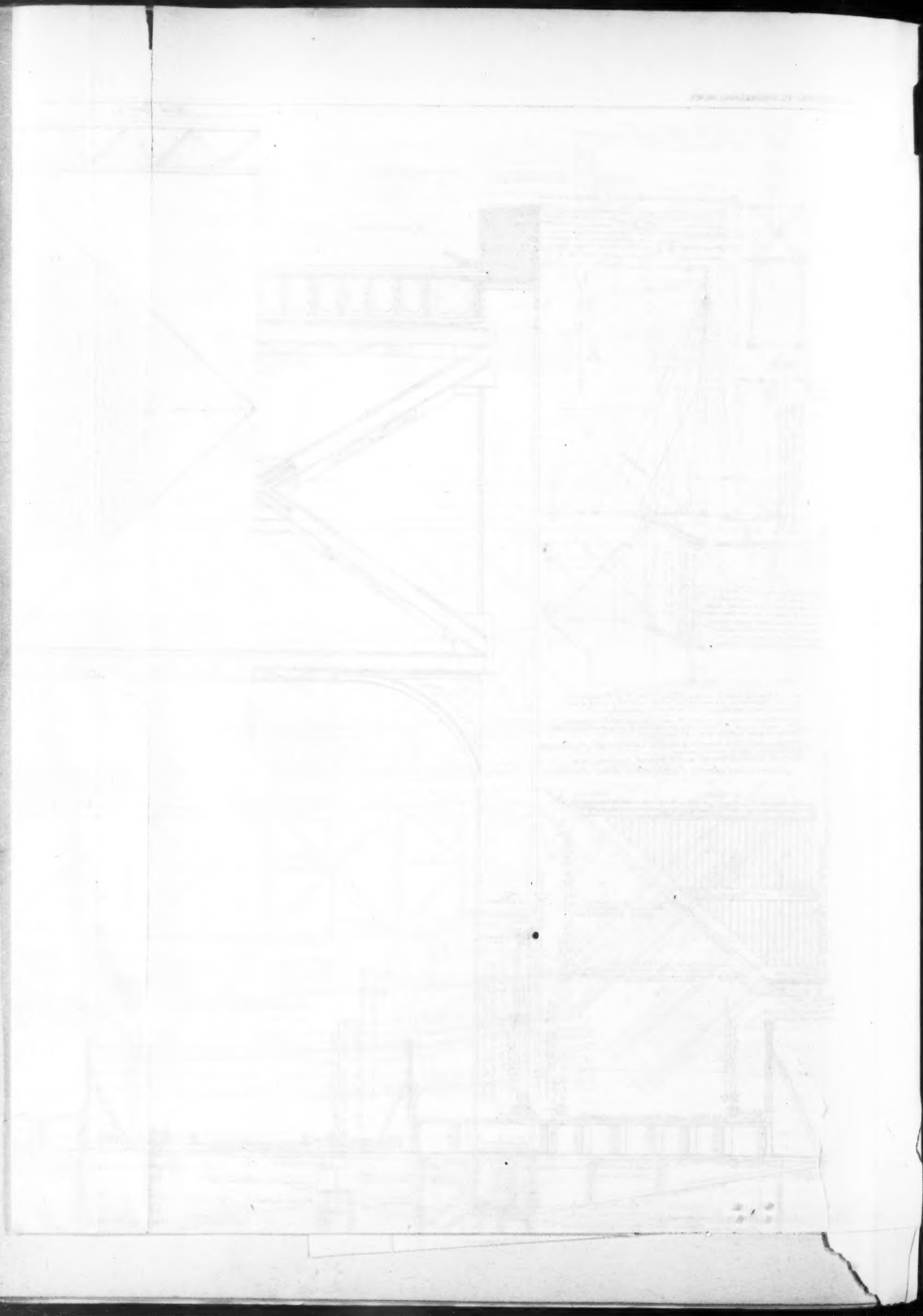
STRAIN DIAGRAMS AND ORDERING SHEET FOR 283 FT. SPANS.

W. E. WINNER, PRESIDENT. KEYSTONE BRIDGE CO., CONTRACTOR. FRANK D. MOORE, CHIEF ENGINEER.




End Beam
Intermediate Beam
End Beam: 2 Beams required.
for one span: alike
This spacing for holes in one side of flanges (either side) of floor beams
Chord Joints 'E' and 'G' alike.
All of Steel unless otherwise specified.
Joint 'G'.
Joint 'E'.
Steel
Through Truss.
Similar Brass Plate at Joint 'E'.
Hangers.
Sway Rods 1¼" Thread Ends upset to 1¼" Iron.
for one span.
Bill for One Fixed End Shoe
(for Roller End Shoe add)
Roller End Shoe
Roller Bed
Bolt for One Fixed End Shoe
Bolt for One Roller End Shoe
Cantilever connection with 'B'
This connection as shown at foot of post
See connection of lateral 'L' above: single 'L' to come above and below
Special care must be taken in making the following pieces
Graphic calculations made thereon and presented herewith
Suspender Co.
Wind stresses due to a uniform pressure of
Chas. Hart & Sons, Lith., 38 Vesey St., N.Y.


Joint 'D'
Joint d,
Rivets in Chords, Posts, Floor Beams and Stringers
Joint 'F' dash lines only ends of transverse to clear diagonals and at this end take one rivet
Struts d, e, and f, g
Joint f,
Bruce 'Bc'
End Stiff Chord a'b'
Section at top of lower flange angles
See Elevation for sizes of pin plates etc
End Top Strut
Portal Developed
Graphic calculations were all made directly on this sheet and preserved here as a matter of record.
Strut h, h
Strut g, g
Strut f, g connection both sides of Post 'G'
All top rivets in vertical rod con. to be marked 'K' are to be 3' below top of post
Splice in Post
Centre line
Portal con. pl
Tie rod
Gusset Pls for Top Struts
Steel pl for Angular bars
Punch rivet holes for rivets
Field Rivets
Top plates
Side plates
Top flange
Bot "
Web "



cisely that, a "better all-around machine." This we claim it to be without prejudice to the many excellent features of English locomotive practice, which we know full well and cheerfully admit. We will only add further that we shall endeavor to do this in a spirit of absolute fairness, and shall allow ourselves some little time before doing so, in order that other duties may not be unduly interfered with. The *Engineer* remarks with perhaps a shade of over-confidence that "our contemporary will have to obtain some information which he does not now possess concerning what really does take place on an English railway," but in this it reckons without its host. We have stores of such information which it does not know of, in back files of the *Engineer*; we shall rarely need to go beyond them.

THE question of direct vs. indirect steam heating of cars has been discussed with increasing earnestness this mild winter, owing to the fact that there has been an unusually great number of days in which the difficulty of heating, without overheating, has been conspicuous. It cannot be denied that the hot water system of heating has certain great advantages, either for buildings or cars, while its practical record for car heating in the well-known form of the Baker and other car heaters is certainly such as to give every encouragement for its continued use. With hot water plant any degree of heat which is a little above that of the surrounding air will suffice to maintain circulation, and as the temperature is raised still higher the circulation becomes more rapid. With steam, on the other hand, there is no practicable medium between no heat at all and 212° to 220° of heat, and this with the further disadvantage that when the supply of steam is shut off the temperature rapidly falls, there being no mass of heated water to postpone such falling. In one way, and in one way only, this disadvantage of the direct process can be overcome—by having an automatic thermostat apparatus which will maintain the heat at just the desired point. There is no doubt that such a thermostat effects a great improvement in direct steam heating, and we are surprised that it has not been used more extensively than it has for car heating purposes. Even with this done there would seem to be a certain residuum of advantage for the indirect system, but without it there is a decided advantage. In some large office buildings, where its chance for maintenance in good order is even less than on cars, the thermostat has proved very effective in regulating temperatures.

An Inexcusable Accident.

It is comparatively rare for an accident to occur which can in perfect fairness and charity be properly spoken of as "inexcusable." To err is human. While many accidents—most great accidents—might perhaps be described as "unpardonable," in the sense that the company should be held to a strict responsibility for them, as avoidable by a proper and due caution, yet in most of such occurrences the danger involved is of such a remote and obscure nature, or the negligence is so closely confined to a single individual, that it is but right to look upon the staff as a whole with a certain charity, as more unfortunate than personally blameworthy, while yet the corporation is justly held responsible.

The Ashtabula disaster was conspicuously such a case. Every individual concerned merited and received such charity. The White River disaster of 1887 was, to some extent, such a case. Even the terrible Bussey Bridge disaster which immediately followed it was somewhat of this nature. The officials knew not what they did in their wretched bridge practice, and the public neglected its duty of compelling them to inform themselves. The Chatsworth, Ill., disaster was also somewhat of this nature. There was a combination of bad and negligent features in it, yet none of them involved that extreme disregard of easily foreseen and well-understood consequences which alone could make it, in the strict sense of the word, "inexcusable." The same is true of the St. George disaster of last year. And even where the accident involves the extreme of negligent forgetfulness in a critical moment on the part of some one employé, as in the Richelieu River and Des Jardines accidents of long ago, we recognize that any one human mind is liable to strange temporary aberrations, and do not regard the accident itself as inexcusable, unless there was obvious lack of proper and established precautions against such chances.

The Hamburg disaster of last week, as described on another page, belongs to none of these categories. It did not arise from remote and unusual causes, but from easily foreseen and frequently recurring causes, whose nature is known to the most ignorant railroad man. It did not arise from the negligence of one man, but of several men; nor from a common grade of negligence, but from what would (we hope) on most roads be regarded as conspicuous and needless negligence. We cannot therefore but regard it as in the strict sense of the word an "inexcusable" accident, suggesting that the general practice of the road is in certain respects most improperly lax, although in certain other and very important respects, which we shall note more fully before we close, we know it to be thoroughly admirable and abreast with or ahead of the best general practice.

The most important single cause of the disaster is one which has not as yet appeared in the public press, and which we had great difficulty in ascertaining, viz., that when the train first broke in two, which appears to have been at Dunkirk, although trouble is also alleged at Cleveland, the air brake hose and coupling pulled off completely instead of pulling apart without injury, as they do when in good order, unless by some rare chance. The safety chains also broke, we are informed, when the coupling parted; the automatic brakes, of course, went on properly, as they must in any and every conceivable case, if the train starts out with them in working order, but the loss of the hose made it impossible to couple up the air brakes again without putting on a new hose. The cause of the break seems to have been a mixture of couplers, a Cowles coupler on the sleeper being coupled to a Miller on the day car. The Cowles coupler seems to have been in bad order.

One of three things should then have been done, neither of which was done. Either (1) a new hose and coupling should have been put on, necessarily taking but a few minutes, or (2) the disabled car should have been set out, taking perhaps ten minutes, or (3) the disabled car should have been switched to the rear of the train, the simplest and perhaps the best remedy, taking still less time and leaving all the rest of the train with air brakes in good working order. Had this been done the single disabled car at the rear of the train would have been in no great danger for lack of brakes, nor would a poor coupling have been especially likely to part. As it was, with almost inconceivable recklessness, the heavy train of ten cars went on in a highly dangerous condition, with the rear and heavier half of it—four ponderous sleepers, the "Salina," "Auburn," "Buffalo," "Mahone," and the dining car "Cleveland"—coupled to the leading cars by a disorganized mixture of couplers, which only "seemed" in good order, and with the air brakes on them absolutely useless and dead. For, although there was doubtless much air pressure still remaining in the auxiliary reservoirs under each car, the train pipe being entirely open to the atmosphere through the unrepaired break, made it was impossible to utilize this air for braking. The brakes were only released after the first break by bleeding each car separately.

If a train in this condition was to be run at all, one would have thought that all the train crew would at least have been on the alert, since they must all have known of its condition, in a general way at least, and a second breakaway was the most natural thing in the world to expect. Had they been so alert, it should have been easy to stop the rear part before collision, or at least, greatly diminish its force, by hand brakes, for too much has been made of the down grade on which the breakaway occurred. It is only 16 ft. per mile, and 3¼ miles long, falling 52 ft. in all. Not a single man of the crew was, in fact, on the alert. The breakaway was not discovered for some time after it occurred, and when it was discovered, the conductor did at once what it is drilled into every railroad man from his youth up, must not be done under any circumstances in such a case. He gave the signal to stop, two taps of the bell, thus showing that he had been giving no serious thought to the condition of his train, for it is inconceivable that he was not aware of the danger of such a stop, before it was certain that the rear part was stopped. Much has been made of this incident, as if he were alone to blame, and his conduct was certainly the extreme of negligence. But this alone would not have caused the accident. The engineman was almost equally to blame. He admits having previously received from the bell cord when it parted the significant *one tap* signal, which is recorded in all train rules as meaning, "train parted," and then the Lake Shore rules, as well as common sense and general practice, requires that "the forward part must not stop until *the engineer* is sure that the rear part of the train has stopped." To this signal, however, as also to a succeeding one, he says he "paid no attention." He claims that he had nothing to do with stopping the train, but that brakes were applied from the train and he "could not release them," but his testimony on this point seems most doubtful, and he could have released them even if so applied had he been on the alert and made the effort in time.

It is idle, therefore, to attempt to throw the blame for this disaster on the exceptional carelessness of any one particular man. Several different employés were exceptionally careless, and only a combination of negligent actions made the disaster possible. Actions, which speak louder than words, seem to indicate unmistakably that some defect of system in the handling of trains was at the root of the difficulty, and affected all alike. It does not seem to have struck any one as such an unusual thing to start out a heavy train at high speed in this badly crippled yet easily remedied condition as to make it worth while to give a second thought to the matter, or even a first thought. We see no escape from the conclusion that they were all proceeding on the run with as blissful a sense of security as if everything had been in the usual good order; whereas in truth the train should never have been allowed to leave Dunkirk in such needlessly bad condition.

We trust the facts will be exhaustively investigated, and the truth or falsity of this conclusion fully brought out; but this is hardly to be hoped for. Our system of investigating accidents is a wretched one. The coroner's inquest is almost always a farce. With the best intentions on the part of the jurymen those interested in glossing over the occurrence and obscuring its worst features, are on hand in force. Those interested in bringing them out, are burying their dead or on beds of sickness. There are no experts for the people present; plenty for the railways. Our railroad commissions do somewhat better, in the few States where they examine into accidents, but they also are not experts, and have good expert assistance only on one side. The only true system is that which has so greatly reduced the number of accidents in England, where government experts, specially detailed for the work, and doing little or nothing else but investi-

gate accidents, report on all serious accidents and expound their causes, practically in the name of the nation, and hence with a weight of authority sure to impress not only the company directly concerned, but all others having like defects of practice. The remarkable results of this policy we showed in our issue of Sept. 21, 1889, and Jan. 11, 1890. Practically, the risks of travel have been reduced to less than one-third of what they were a dozen years ago. To this system of prompt investigation by trained experts, we also must come, and the sooner we do it, the better for all concerned, both the public and the railways.

Failing such a system, the full moral of such disasters is appreciated and profited by only on the road immediately concerned. The rest of the railway system is not duly impressed by it, since it is not officially made public, with the weight of authority, by men known to be competent and impartial. The consequence is that while the management of most of our great lines is in the main thoroughly good, many of them have single features of bad practice which they are slow to abandon until they individually suffer the consequences of it, and in such serious form as to attract wide public comment. Thus the Pennsylvania Railroad, which in almost every detail of good management stands distinctly at the head of our railways, is at this moment giving the great weight of its example to a system of car lighting by gasoline, which is as certain as anything in the future can be to result eventually in some frightful holocaust; nay, which almost certainly would have done so in this very accident had the system been in use. For in this accident one car completely telescoped the other, and the high proof (300° Fahr. we believe) oil lamps by which the car was lighted remained burning, and were on the very point of starting a fire when a porter courageously rushed in and tore two of them from the cars. Now, what would have been the probable effect of having six or seven two-gallon tanks of gasoline heated to a vaporizing temperature along the roof of the under car, while such telescoping was going on, and the lamps of the upper car were burning above it, each likewise provided with its two-gallon tank along the roof? More favorable conditions for fierce and instant combustion can hardly be imagined; and any competent and conscientious government expert, such as are employed in England, would be pretty certain to point this out in words not to be ignored. As it is, we may probably have to wait until some actual disaster of the kind on the home road compels too late the recognition of a danger which ought already to be clear enough.

Similarly, the great St. George disaster of a year ago, on the Great Western Division of the Grand Trunk Railway, was due to a combination of excessively high speed, unduly thin tires, and imperfect bridge floors. Its neighboring roads of the Vanderbilt system, including conspicuously the Lake Shore, have the very best of good practice in regard to both tires and bridge floors. No tire on fast passenger trains is put in service less than 2 ins. thick on either road, and the Lake Shore uses in addition the Mansell retaining rings, making its tires, humanly speaking, absolutely safe. The Boston & Albany has the same practice, and the Pennsylvania also, as to thickness of tires for fast engines, if we are correctly informed.

The tire which caused the St. George disaster was only 1⅛ ins. thick, and was making 60 miles per hour at the time of the break. It was used, we fully believe, without due cognizance of the more cautious practice of its connecting lines, and we apprehend that there are many of the Westernroads at this moment which are continually quickening their schedules on not over-good track, and yet do not realize the special caution as to tires used by the Eastern lines running limited expresses, as they would be led to do by adequate expert reports in the English style on a disaster like the St. George.

The same is still more true as to bridge floors. Both the Lake Shore and the New York Central, as also the Pennsylvania, are following the best possible practice in this detail by eliminating them altogether where they can by stone structures or, (in the case of the Central) solid iron and ballast floors. On all important structures their practice has for years been growing continually more cautious, yet the contagion of example alone is certainly not as effective in many instances as it should be.

We do not put forward the English system of expert investigation of accidents as a panacea. We are aware that it has been slow in bringing about certain reforms in English practice, as notably in the use of the best brake gear. We do believe, however, that progress has been quicker even in this than it otherwise would have been, and it is certain that that or something else has been in recent years having a healthful, quickening effect on English practice which as a matter of fact has had the truly remarkable effect noted above to decrease the number of casualties.

To illustrate the system, we may take up at random a single quarterly issue. In that quarter there were 57 train accidents, 3 deaths and 262 injuries reported, the ratio of injuries to deaths alone showing that every casualty is very completely reported, as the law requires. Of these 57 accidents, 13 only were officially investigated, 6 by one officer, 5 by another, 2 by another, but for each of these there is a full analysis of all the circumstances and the evidence, with the findings in large type at the close, in which all defects of practice contributing to the accident are fairly, but fearlessly summarized. The natural effect of such public scrutiny of *every accident* (for all are scrutinized for cause for investigation, although not all are investigated) is to check defects of practice in their incipiency, not only on one, but on many roads; and especially to check those individual oddities of practice which will creep in on single roads or divisions or in single classes of services, when each road is permitted to enshroud its accidents in secrecy, as all our American roads now seek to do, naturally enough.

If there be a mode of "regulating commerce between the States" which might be expected to result in good to all and real harm to none, it would be to require every train accident in the United States on roads doing inter-State business to be reported as promptly to some government authority as it is to the superintendent, to be all properly tabulated and published at the end of the year or quarter, and in the case of a few of the more significant ones only (not necessarily the more serious ones), promptly investigated on the spot by independent experts trained to the work. In England two or three officers of the Royal Engineers are detailed to this service. Like details from the U. S. Engineer Corps might hardly be expedient here. The appointments might better be from civil life. They need not be many. Four or five, or even one man, each investigating, twenty to forty selected accidents yearly, would suffice to accomplish much. The public record of *every* train casualty, the liability of any one of them to be publicly investigated by some one who knew what he was about, and the care with which reports of this nature would be scrutinized by all railway officials, would be enough. Accidents would not cease. They never can do so. But we fully believe they would become much rarer than they now are, and that accidents of the inexcusable character would become extremely rare.

President Blackstone's Plan for Government Railway Ownership.

The scheme for Government railway ownership proposed by President T. B. BLACKSTONE of the Chicago & Alton, and briefly outlined on page 206 of our issue of Mar. 1, is the first case where a railway man of Mr. BLACKSTONE's prominence has come out explicitly in favor of Government railway ownership. On account of the source of the scheme it has received much attention and discussion; and much surprise has been expressed that the president of a railway corporation, of all persons, should come out in favor of the new doctrine of Nationalism as applied to railways. But it is not generally realized how strong are the social and political forces which are setting in the direction of Government railway control. Mr. BLACKSTONE is not by any means the only prominent railway manager who looks forward to some settled relation between the Government and the railway corporations in place of the present unsettled and uncertain one. Of course it is true, however, that as a body railway managers are highly conservative on this question. There are very few who, like Mr. BLACKSTONE, are willing to give up to the government the ownership and management of a road paying steady dividends of 8 per cent.

It is by no means the railway managers who would take the lead in advocating government control or ownership. The influence that is working to this end is a far more subtle and powerful one than the railway managers can bring to bear. Let us take the work of the single organization generally known as the Farmers' Alliance. Its membership now extends all through the South and West, and almost the whole of the farmers in the districts where it has been established are on its rolls. It is busily at work already to bring about the establishment of railway commissions in those States where commissions are not yet established, and its demands are pretty certain to be heeded. It is not at all likely that it will stop at this success. Many of its leaders are thoroughly committed to the policy of State ownership of commercial channels, and the platform of the Alliance is already tending strongly in that direction. The movement is surely destined to become a political one, unless legislators unite, irrespective of party, to inaugurate the desired changes before they are made a party issue, as was the case when the Interstate Commerce law was passed. The agriculturists of the country constitute nearly one-half the total industrial population. It is a rash politician who will venture to oppose their wishes when once they are united on any point.

This, however, is but a part of the force tending toward the nationalization of the railway system. The various labor organizations are more united than the farmers, and even better able to wield a strong political influence. They are being thoroughly educated every day in the doctrines of State socialism. They look with a jealous eye on the reign of great corporations, and while their schemes of government control will by no means stop at the railways, they will be quite willing to unite with the farmers to place the railways under Government direction and control.

Still, a third influence in the same direction is working in the literary and educational world. Many professors in our colleges, lecturers, preachers and influential editors are to be found who reject the old political economy, and place in their new creed an article of faith in the State's powers and duties with regard to industry and commerce quite contrary to the old orthodox belief.

These, in brief, are the forces working toward the Government ownership of railways. We do not propose to discuss here the chance of their success. It is evident enough that they are forces by no means to be despised, and that their chances for success are such that instead of treating Mr. BLACKSTONE's proposal in a flippant manner, as many of our contemporaries have done, it should be given serious consideration, as a plan to meet new and changed conditions which railway managers may find it necessary to face.

Most of the features of Mr. BLACKSTONE'S scheme can hardly be considered novel. His chief argument is about as follows: The capital invested in the railways of the country now pays probably 5 to 6 per cent. on the amount actually invested. It has to pay high rates because of the risk involved. But if the roads were all owned by the Government, failure of interest on bonds would be impossible and capital could be secured probably at 2½ per cent. for the purchase of all outstanding securities. The rates would be fixed at a point sufficient to pay the operating expenses and the interest on the bonds, with 1 per cent. additional to a sinking fund to pay the bonds when due. As the payment for fixed charges would be very small compared with the present, the rates of transportation could be considerably reduced, providing operating expenses did not increase.

The only point of especial novelty in Mr. BLACKSTONE'S scheme is the way he meets what has all ways been an unanswerable argument against entrusting to Government the control of industria matters; namely, that the management of the railways would be a political matter, and that influence, and not ability, would be the moving force in making up the personnel of the Government railway corps. This Mr. BLACKSTONE proposes to obviate by a simple requirement as to tenure of office. The whole system is to be governed by a board of directors appointed by the President, who shall hold office during good behavior, and shall control the whole maintenance and operations of the roads. The operating officers and employees are to be appointed "on probation" for one year, and after that time are not to be discharged without sufficient cause and proper investigation.

Mr. BLACKSTONE says that with these precautions he sees no reason to fear that the corps of railroad operators would be made a political factor, and he believes that the provision that the national board of directors should hold their offices during behavior would secure them the same freedom from political bias and personal favoritism which now obtains with judges of the Supreme Court.

Whether these provisions would suffice to keep the railway service out of politics or not is a matter on which opinions will differ; but there can be little question that while the tenure-of-office requirement may be necessary, it would be an obstacle to the successful and economical operation of railways which does not now exist. The valid objections to government action in industrial affairs will be by no means entirely removed by taking the civil service out of politics. The requirement that no man shall be discharged except for cause, operates on the one hand to keep good men in the service, on the other to make more difficult the weeding out of the incompetent, the reckless, and the lazy. It is out of the question to expect that favoritism will ever be abolished in either government or corporate service. We do not overlook the fact that it is a potent force today under the present system. It will exist under any system, and the only question is whether it would be a more formidable evil when the men in charge have no pecuniary interest in the results of operation than to-day, when railroad directors are supposed to have some direct personal interest in securing faithful and efficient management for the property in their care.

This, after all, is the critical point in this as in every other scheme for placing the railways in the hands of the Government. Can we venture to entrust the management and contrcl of our railways to men who have no personal interest in securing efficiency and economy in the service? On the one hand is to be considered the fact that the present day the actual owners whose interests are at stake have very little to do with the management of the railways. Directors are apt to have merely speculative interests in the companies they are supposed to control. Not all railway servants are honest or efficient to-day. On the other hand, will the added red tape, the lessened sense of direct responsibility to owners, the tendency to delay improvements and stick in the old ruts, which certainly will come with complete government, ownership and management, result on the whole in less efficient and economical management?

The question is much too broad a one to be discussed in detail here. There are many valid arguments that may be presented on both sides. In general, however, it can certainly be said that neither the public, the Government, or the railways are yet ready for the reform proposed by Mr. BLACKSTONE. If it does come about, the change should be made gradually. Before such extreme measures are inaugurated it will be well to try more moderate plans, and see if the chief benefits cannot be secured by Government control, while maintenance and operation are entrusted to private companies.

No criticism of Mr. BLACKSTONE'S scheme is complete which does not refer to the astonishing statement which he makes concerning the financial condition of the railways. Why he should take the present time to set forth an extended declaration that the railroad business is all "going to the demnition bow-wows," to use the expressive words of Mr. MANTALINI, passes comprehension.

It is indeed true that Mr. BLACKSTONE refers to future prospects to some extent rather than to present conditions, but almost every one who reads his sorrowful cry of distress will take it as referring entirely to the present status of affairs. Sensible people will look to the report of Mr. BLACKSTONE'S own road, earning 8 per cent. dividends last year, and to the reports of earnings on all railways for 1889, showing an increase in net earnings of about 13 per cent. over 1888, and will wonder what all the row is about anyhow. The newspapers all over the country are taking it up and using it as a text to prove that the railways' plea that present rates of fare and freight are not remunerative is not to to be relied on.

One of ÆSOP'S fables describes the fate that befell the lad who was set to watch the sheep and gave the false alarm of "wolf, wolf." There is already a general belief on the part of the public that stories of railway poverty are not to be believed. So doleful an appeal as Mr. BLACKSTONE'S is at the present time well calculated to confirm the impression, and do far more harm than good to the railway interests.

CORRESPONDENCE.

The "New Era" Grader can build Irrigation Ditches.

LAMAR, Colo., March 2, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR:—A copy of your paper of Jan. 25 has been handed me by a civil engineer, asking my views in regard to an article from the pen of a Mr. L. A. HICKS, of Arizona. Being an old grader man, I had no trouble in satisfying him, and thinking the matter over I concluded that as the article of Mr. HICKS is very unjust and misleading, liable to work injury both to contractors who need such machinery, and also to the manufacturers, and notice that you say in publishing his article: "If his objections can be answered, it must be by others than ourselves." I consider it both my duty and privilege to reply.

I own five New Era graders—have used them four years I have used them in building 152 miles of large canal and hundreds of miles of lateral branches, in what is known as the Colorado and Kansas Canal and Reservoir, and the Amity Canal and Reservoirs Co.'s canal, and am personally acquainted with many other New Era men who have altogether built thousands of miles of canals in the district embracing Colorado, New Mexico, Arizona, Utah, Idaho Wyoming and Montana, and consider my knowledge, experience and familiarity with the soil to be handled and th expense of the various methods of handling, should carry far greater weight than the opinions of one who never operated a New Era, as his statements are ample evidence.

Mr. HICKS, in face of the facts I have stated as to the enormous amount of canals that the New Era *has built*, states that in the "construction of canals" the machine is "totally unfitted." Theories must fall when disproven by facts. The next weakness of the grader is "the difficulty of obtaining a good water-tight joint between the artificial bank and the undisturbed earth."

While there may be places where it is difficult to make such a joint, where I have worked nothing of the kind has been necessary; and if it were necessary every grader man knows that the excavation of a small trench, or plowing two or three rounds of back furrowing at a point over which the new embankment is to rest, would be sufficient.

I have further found that the way the New Era places the earth in embankment in continuous layers running parallel to the excavation settles the embankment more solid and compact than when built by any other method.

The miles I have built and filled with water show me that the water seldom soaks into the embankment more than 18 ins.

I wish also to contradict his theory with my personal experience, and to say that the New Era will work in any soil where a plow will, and that it *will work* in a soil containing gravel stones, and it is rare to find gravel so free from soil that the New Era will not put 1,000 or more yards into an embankment per day. Clean, round, washed gravel might not all go over the carrier, *but most of it would;* and while, as Mr. HICKS intimates, these machines were not designed for "the alluvial valleys of the South west," the builders "builded better than they knew," for there is no place on earth where they work better than in the very locality where Mr. HICKS would condemn them. What object Mr. HICKS can have in endeavoring to discourage the introduction of these machines in a country where they are *so much needed* (being the best and cheapest implement for the development of irrigation), unless he has a spite against either the country or manufacturers, I cannot imagine; but I stand ready at any and all times to disprove his statements, and invite everybody to examine the canals I have built with the New Eras as a complete refutation of all he claims.

The statements made by the New Era manufacturers I have never found exaggerated.

While they claim the New Era will put 1,000 cu. yds. of earth into an embankment, I have found my average about 1,600 yds. As a wagon loader it will load 600 to 800 wagons and *load them full* from a yard to a yard and a half to a load; and from the years of experience I have had with this, which I consider the king of earth-moving machines, it is only justice and fair play to say to all contractors for all the requirements of earth moving, the New Era will make a contractor rich where he would otherwise starve to death.

Hoping that I have not trespassed too much on your space, I remain, Yours, respectfully,

F. B. KOEN.

President and Gen. Manager Amity Canal and Reservoir Company.

On the same subject Mr. C. F. HINMAN, of Chicago, Ill., writes:

Since 1870 I have handled the graders for many years, although not under the present management, and I have an abiding faith in the superior merits of this earth-moving implement. Mr. HICKS starts in by sounding a warning note to contractors, to the effect that the New Era is "totally unfitted" for the "construction of canals," which statement can be proven utterly false by reference to the hundreds of miles of canals which *have* been built in Arizona at no great distance from him by the New Era grader. He then tells us that "fully 60 per cent. (usually more) of the work on any surface irrigating canal will consist in building artificial banks." Having myself built miles of "artificial banks" in railroad embankments, levees, country roads, etc., not to mention canals and ditches, and having put from 1,000 to 1,800 yds. per day into grade at a cost of less than two cents per cu. yd. or one-third of what it would cost if so placed by any other appliance, it makes me smile to read that the New Era grader for such purposes is "totally unfitted."

Mr. HICKS mentions the difficulty (!) of making a lock or joint between the natural earth and the artificial em bankment, although why that should reflect on the grader more than on any other method he fails to make evident; but as he seems to think it a great difficulty I will tell him how experienced and practical men accomplish it when necessary. Where soils are porous from grass or brush roots it is sometimes necessary to plow out two or three furrows at a point underlying the proposed embankment; this properly tamped in and commingling with the earth of the new bank makes a joint, and scrapers or graders can then build the bank. Mr. HICKS proceeds to tell us of the necessity of making a bank solid "by tamping, rolling and the tramping of horses," and for *this reason* the grader is "totally unfitted." I had not supposed that there was any law in Arizona prohibiting grader men from using the same means of "tamping and rolling," etc., that other excavators did; but as Mr. HICKS seems so ignorant would say that it is usual to put a harrow right after the "dropper," as he terms it, to follow steadily the falling earth, level, smooth, and tamp it solid, and so make the finest possible bank equally dense and solid, so it settles level and uniform.

Mr. HICKS says the statement made by the New Era grader people that the grader will work in any soil where a plow can be used, is untrue. With the exception of where a stone plow is used for quarrying loose rock, I do not know of any place where a plow can be practically

used that the grader will not successfully work. Sand, gravel, loose soils, hard pan, clay, gumbo—I have worked it successfully in all, and it never failed to work where horses could draw it.

I met a grader man to-day, one who has worked them for 18 years, from Winnipeg to Texas, from Ohio to California, not excepting Arizona, and he says: "The nicest soil in the world for a grader to work in is those very alluvial valleys." Thus do facts and fiction vary. It is too late for Mr. HICKS to try to injure the well-established reputation of the New Era; it has too many champions to rise in its defense.

Mr. C. C. TAULPHAUS, of Eagle Rock, Idaho, who is one of the owners, and is now building 86 miles of ditches for the Idaho Canal Co., tells us under date of Feb. 15:

Mr. HICKS' letter does not tally at all with my experience, and I want to go on record as a friend of the New Era; and I feel qualified to speak for it from long experience in its use in doing just the work Mr. HICKS says it cannot do. As to its not making a tight bank, I would say for Mr. HICKS' enlightenment, as well as that of other readers of your valuable journal, that no matter whether the excavation is made by plow, by scrapers or by the New Era, a back furrow should be made on the actual bank before the artificial bank is thrown in, if the soil is such as to require it. This will prevent water from seeping through the bank.

Then I have never found any earth in this country that the New Era won't handle satisfactorily. I am using the very machine objected to on my work—one I purchased five years ago—and in the spring I intend to buy several more for the same work. I have tried all manner of appliances for handling earth, and have not yet found anything that will put a given quantity of earth into embankment at as low a rate per yard as the New Era, or that would do as clean a job on ditch-work.

Mr. HICKS think that in a prairie country the machine will do all that is claimed for it by the makers; that is, to put 1,000 cu. yds. in embankment in 10 hours. I want to tell Mr. HICKS, and ditch-builders generally, that two years ago last fall I found myself with a large amount of unfinished work on hand—ditches that were urgently needed to get water on land I wanted to reclaim. Failure stared me in the face; but I had faith in the New Era and plenty of teams, and so I put the plow down and let the dirt fly. I can safely say I put 3,000 cu. yds. per day into embankment for many days in succession, and the New Era saved me $20,000 that I would have lost had I been compelled to depend on any other style of earth-mover.

As to the dust on the Arizona roads, I would say we do not plow our roads into canals, and it takes more than "a few rounds" on our undisturbed soil to reduce it to the fineness of road dust.

[We devote the space given to these letters because, in our opinion, they very emphatically refute the statements of Mr. HICKS, who does not state that he has actually tried the machine objected to, but rather bases his objections on what he *thinks* they can not do in his region. We have other letters from people actually using this machine in the West and Southwest; but they practically repeat the experience given above, and lack of space forbids our publishing them. We only regret that Mr. HICKS' letter got "on the hook," and unintentionally into print before answers could be published with it, as is our rule in similar cases. But the actual experience here drawn out ought to satisfy even Mr. HICKS and dispel any doubts to which his letter may have given rise.—ED. ENG. NEWS.]

Mexican Practice in Vertical Curves.

JALAPA, MEX., Jan. 31, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: Something on vertical curves that I hope will be of interest for the readers of your engineering paper:

Here in Mexico we use the metric system for railroad work, but the foot system will give about the same result, except that the total length of vertical curve will be a little shorter.

The following formulæ was used in the location of the Mexican National R. R. between San Miguel de Allende and Saltillo by the directions of Mr. H. H. FILLEY, Chief Engineer, and it is so simple and easy that any engineer will work it without any trouble, even in the field while running grades, and only takes about two minutes to figure each curve.

First the grades should be calculated as if no curve existed, for the two meeting grades; then apply the following formulæ:

Call the divergence of the grade lines, or the algebraical difference of the two rates of grade per 100 ft. = "A."

Then, the distance from grade line or tangent to the curve will be:

At intersection of grade or apex	dist.	=	0.25	"A"
1 chain or 50 ft. either side of apex	...	0.16	"A"
2 chains or 100 "	"	"	"	"	"	....	0.09	"A"
3 "	" 150 "	"	"	"	"	...	0.04	"A"
4 "	" 200 "	"	"	"	"	....	0.01	"A"
5 "	" 250 "	"	"	"	"	....0.00	end of curve.

Breaks of grade to be made by vertical curves wherever the change of direction amounts to 0.50 per cent. or over. The total length of curve to be uniformly 500 ft., extending 250 ft. either way from intersection, which must occur on an even chain. So that the number of chains (measured from intersection) square, multiplied by the difference of grades, and divided by 100, will be the corresponding ordinate at any chain.

Of course the formulæ used here refers to chains of 20 meters, which makes the total length of curve uniformly equal to 300 meters (5 chains either side of meeting point of grades).

Say, for instance, that a vertical curve is required to unite the two following grades: + 2.0 per cent. and —1.0 per cent.

The algebraical difference will be $+2\% - (-1\%) = +\% + 1\% = 3\% = 3.0$.

Then at intersection will be	.....	=	0.25	×	3	=	0'.75	lower
50 ft. either side	.....		0.16	×	3	=	0'.48	"
100 " "	.....		0.09	×	3	=	0'.27	"
150 " "	.....		0.04	×	3	=	0'.12	"
200 " "	.....		0.01	×	3	=	0'.03	"
250 " "	.....		0.00	or tang. point.

If the grades were + 1% and + 2% the difference = — 1, and we have the following for successive statures:

0.25 × 1	higher.
0.16 × 1	"
0.09 × 1	"
0.04 × 1	"
0.01 × 1	"
0.00	—

Begging you to excuse my English, as I am a Mexican I remain, yours respectfully, E. ZAYAS, C. E.

[Our correspondent need not apologize for his English, which is very good; as is also his method. It has the objection that it does not vary the length of the curve with the sharpness of the angle between grades, but with freight train brakes and close couplers this will become far less important than with the present imperfect devices, and the better practice bids fair to so soon become universal that it is admissible now to base construction practice upon the assumption that they will be used. Nevertheless, there should be some reasonable limit as to the sharpness of grades which it is permissible to intersect by these rather short vertical curves, and this should not be more than about one per cent. difference in rate. *Our correspondent's numerical example above would be distinctly bad practice*, amounting to a change of 3.0 per cent. in rate in 500 ft., or 0.6 per cent. per station. This is too much. An intermediate grade or longer vertical curve should be used in such a (very unusual case.—ED. ENG. NEWS.]

The Rockcliffe, Ont., Collision.

ALMONTE, Ont., Feb, 18, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: I inclose you a clipping from the Ottawa *Free Press* of Feb. 13, being an account of a collision of two passenger trains which occurred on the morning of the 12th. I also inclose you a part of the time-table as published in folders by the C. P. R. Co.

It appears that conductor P. CADIGAN, in charge of the Pacific Express going west, got orders at Mackey to cross the "Soo" express going east at Rockcliffe. He, according to the rules of the company, carried the orders to the locomotive driver and got his signature on one copy of the order, which he (CADIGAN) retained. The train started out, ran PAST Rockcliffe about a mile, where they met the "Soo" train on a curve, with the result stated in the clipping—a bad wreck and several injured, though not seriously.

CADIGAN'S driver (WILSON) now claims that CADIGAN read the order to him and said they were to cross at Klock, and that he (the driver) did not read the order himself.

Rockcliffe has no night operator. The C. P. R. is enjoying a very heavy freight business on this division, and has a practice of running two or three trains in the same direction, close after one another, sometimes at very short intervals. These two were running close together; the first one stopped at Arnprior and the second one ran into the rear end of it.

Had the collision at Rockcliffe occurred half a mile further west, where there is a high trestle, it would have been a miracle if any one had escaped being killed.

A short time ago you stated to your readers that you would be obliged to them if they would send you accounts of railway accidents as soon after they happened as the facts could be obtained. I have accordingly sent you the above. E. C.

[We are obliged to our correspondent, and to all others, for early data as to all casualties of technical interest, and we will also repeat that we are always ready to defray all reasonable expenses incurred to that end in our behalf. The above accident, if correctly reported, is another illustration of the fact that it is never safe for train orders to filter through the conductor to the engineman, but that each should receive their orders in duplicate independently at first hands, read and report their understanding of them, and have a copy of the orders on their person before proceeding.—ED. ENG. NEWS.]

The Deflection Test on Old Bridges.

NEW YORK, March 8, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR:—The taking of deflections of a bridge, and especially an old bridge, which has been overloaded perhaps thousands of times, for the purpose of determining its reliability for further service is such an absurdity that I am surprised when I see it mentioned at the present day.

In my opinion it is a criminal absurdity, for it is giving frequently a certificate of safety, to the public, which is absolutely false.

The deflection of a bridge is simply the summation of the deformations of all the members of a truss acting with their proper leverages. Numerous important members may be at the critical point of rupture without any perceptible effect upon the deflection or the permanent set.

In the majority of cases, from my own experience, the critical point in defective structures is in some detail, which would still less likely be indicated by the deflections.

A generally weak and defective structure which has had the set taken out of the members by frequent overloadings would also be little likely to indicate any permanent set.

Such a structure might go down at the very next loading to the one which had been used as a satisfactory deflective test.

Any corporation or State official who depends upon such tests as indicating the reliability of any bridge should be held up for public scorn.

Bridges should be examined by persons having sufficient experience and knowledge of the subject to seek the true evidences of their condition and be able to judge from the evidence what the bridge is capable of doing under the service to which it is subjected.

Yours very truly, THEODORE COOPER.

The Properties of Aluminum.

PITTSBURG, March 10, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: Inadvertently, in our paper upon "The Properties of Aluminum," and of some information relating to the metal, under the head of "Aluminum in Steel," the statement that the influence of aluminum is to lower the melting point of the steel, and in this way make it "more fluid," and also that it "tends to make the ingots of steel more solid and more free from blow-holes," is left without quoting authority. This statement should have been made to read that it is frequently stated that such are the results.

We wish that you would make this correction in your paper, as we shall in the revised manuscript for the Transactions of the American Institute of Mining Engineers, as it was the intention of the writers to make no statements which they had not actual personal knowledge of, or for which they were not able to give the exact authority; and while a large amount of experience tends to strengthen the belief that the influence of aluminum in steel is as described, at the same time, the accuracy of these statements has been questioned.

Very respectfully, ALFRED E. HUNT, *et al.*

A Correction of North River Bridge Reports.

BALTIMORE, Md., March 6, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: I beg space in your journal to correct an impression, which may have been created by some garbled press dispatches, having reference to the bill before Congress for the North River bridge. I am, among other things, represented to have said before the Congressional Committee that the plans have the endorsement of the American Society of Civil Engineers. I have said no such thing. I should add, as a matter of course, every member of the Society knows that, under its rules, the Society does not and cannot endorse anything. It is difficult to make lay minds understand the professional proprieties on such subjects, and it is not a pleasant sensation to be, perhaps unwittingly, represented in newspaper dispatches as thus violating them. I cannot possibly keep track of all incorrect reports, but this one seems to me to call for correction in justice to myself.

Your truly, G. LINDENTHAL.

Notes and Queries.

A Charleston, S. C., correspondent asks: Will you kindly name best source from which to get latest plans, etc., for ornamental shed at a railway picnic grounds, as well as small depots of late design? In the rush of work I have not the time to spend on this, and seek the result of the thought of others less actively engaged.

We have published from time to time some drawings of this kind, and in PARSONS' "Truck" [ENG. NEWS, 82] will be found others; but we advise our correspondent to get sketches from an architect.

CONSTANT READER asks for information, and preferably tests, showing the ultimate resistance and the elastic limit of ordinary structural steel *in compression*. This information has particular bearing on the safe working load per square inch on columns and posts made of the best American structural steel, preferably "open hearth." We do not know of exactly the type of tests on steel in compression here asked for. Perhaps some of our readers may be enabled to answer better.

The Shield for the Hudson River Tunnel.

The shield illustrated is the one originally devised by Sir BENJAMIN BAKER, C. E., for use in the Humber tunnel in 1873, and as here shown is especially proportioned for the excavation and lining of the Hudson River tunnel. We are indebted for the original from which the cut is made to Mr. WILLIAM R. HUTTON, C. E., Chief Engineer of the Hudson River tunnel.

As shown on the cuts, this shield is made up of a steel shell, 19 ft. 6 in. in clear inside diameter, and 10 ft. 6 in. long; two diaphragms provided with nine doors and seats for 16 hydraulic rams; a cutting edge on the entire front circumference and two horizontal cutting floors or shelves as shown. The general dimensions of the several parts are given on the section and elevations.

In operating this shield it is pushed forward into the silt by sixteen hydraulic rams of 100 tons capacity each, abutting against the seats represented on the back end of the shield and the masonry lining of the tunnel. Ordinarily the doors in the diaphragm will be open, and the material excavated in the front compartment will be passed to the rear through these doors. But as the lower edges of the door openings are somewhat higher than the upper edge of the openings in the forward diaphragm, there is actually a locked caisson in each of the nine compartments when the proper doors are in place. Consequently, in bad ground, it is possible to close the rear diaphragm with fixed plates and doors, and to remove the material either by ejectors or through the air-locks. As shown on the cross-sections the nine compartments are formed by the two floors and two vertical and longitudinal partitions, each compartment being independent of the other in its working, and allowing an almost equal attack on every part of the face of the tunnel.

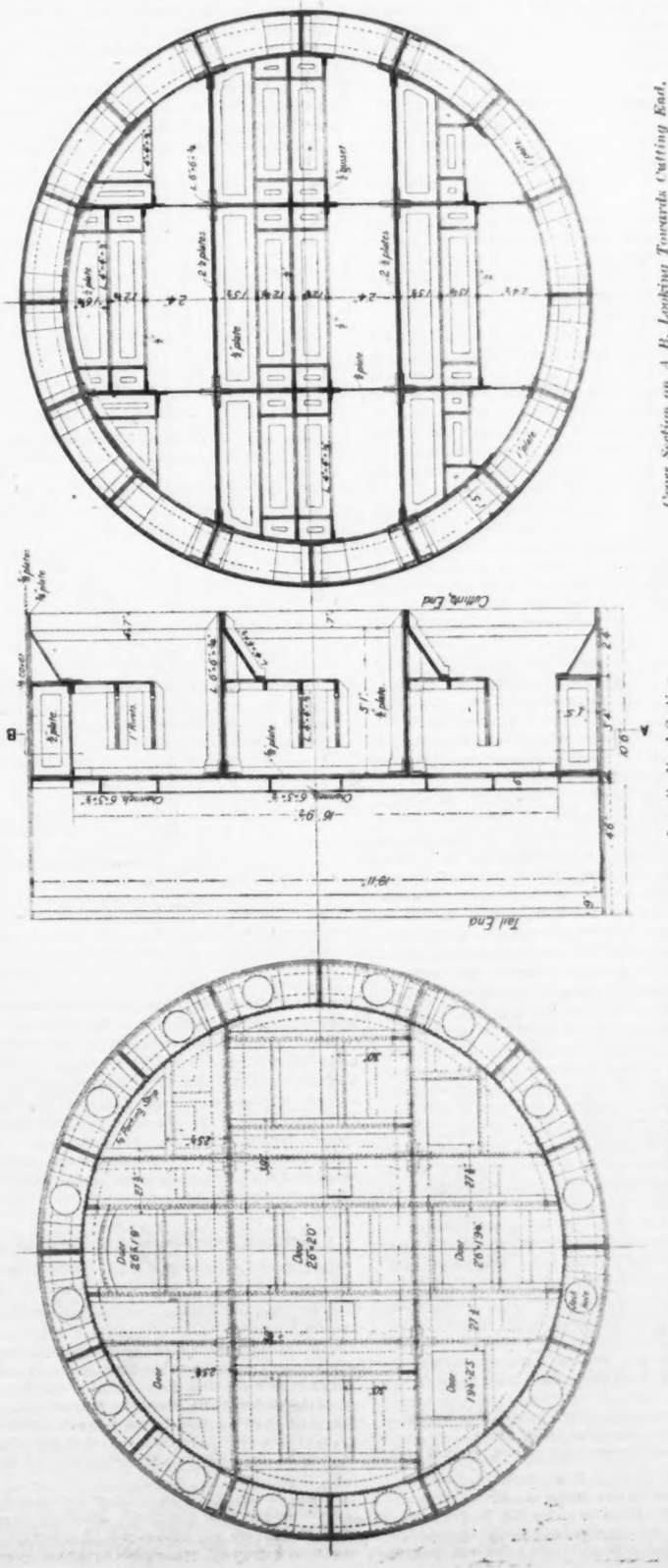
While the excavation is being carried on the tunnel lining of cast iron is bolted in place inside the rear end of the shield. This lining forms a true circle 19 ft. 6 ins. in outside diameter, and is made up of nine segments and a filling piece to each ring, and the width of the ring is 20 ins. These segments vary in thickness and weight; to a point considerably above the centre line they weigh 1,176 lbs. each; the next segment weighs 896 lbs., and the next 840 lbs., with a short closing-piece of 224 lbs. These segments have vertical flanges 8 ins. by 1⅝ ins., and horizontal flanges 7¼ ins. by 1⅝ ins. The bolts used are 1¼ ins. diameter. Each segment has three about equi-distant flanges running across it, with a central lifting lug cast upon it. The holes in the vertical joints are spaced about 11 ins. between centres; while in the longitudinal joints there are three bolts to each 20-in. ring. The closing-piece is wedge-shaped, with the point upward, and is heavily ribbed and bracketed.

It might be mentioned that no holes are provided in these cast segments for ejecting grout between the lining and the surrounding earth, as was done in the Thames Subway Tunnel, now about finished. This grouting was necessary in the rather stiff London clay, which could not be excavated to exactly fit the ring; but the silt through which the Hudson River Tunnel is being driven will settle back so snugly as to make this grouting entirely unnecessary.

Professional Water Finding.

In the month of December last we were requested by Messrs. HEERDEGEN & SCHNEE to make an investigation into the claim of the former gentleman as to his ability by means of an instrument he had invented to discover subterranean water. Mr. HEERDEGEN is an electro-technical engineer, as it is termed in Germany, a Bavarian by birth, but recently residing in Russia, and it was when there that he declares himself to have accidentally made the discovery of his apparatus. He brings with him a record which shows upon its face a most complete success for his efforts in Russia, and the certificates to this effect and the recommendations from houses of the highest standing in Moscow and elsewhere, leave no doubt that many have a genuine belief in his powers or those of his instrument. He certainly showed so good a *prima facie* case as to make investigation seem proper.

We have done our best to test the accuracy of the claim, in conjunction with the editorial staff of the



THE SHIELD FOR THE HUDSON RIVER TUNNEL.—WILLIAM R. HUTTON, C. E., Chief Engineer.

Cross Section on A B, Looking Towards Cutting End.

Longitudinal Section.

Elevation of Tail End of the Shield.

Engineering and Mining Journal, but from the outset we were confronted by two obstacles in the way of arriving at perfectly conclusive results. The first difficulty lay in the fact that the alleged instrument is not patented, and that therefore Mr. HEERDEGEN declined to give details of its construction, and although we were allowed to see and to handle it, and even to try its operation ourselves, we were wholly unable to follow the principles that govern its actions. The other difficulty was that Mr. HEERDEGEN's claim is to be able to locate underground springs or streams under natural conditions, and it is evident that the only method of testing this conclusively would be to select a site where there was no knowledge or presupposition of subterranean water supply, and to test the accuracy of each prediction by sinking to more than the depth indicated by Mr. HEERDEGEN, for Mr. HEERDEGEN claims to be able to indicate depth approximately, as well as the mere existence of water, though he disavows all connection with "witch hazel" processes, and claims that his method is purely scientific.

Mr. HEERDEGEN was, however, willing to waive these natural conditions in their strictness, believing that his instrument would enable him to locate running water equally well in iron pipes or in brick or masonry conduits, and on this supposition the trials were carried out.

The first tests were made on the line of the new aqueduct in the neighborhood of Sing Sing, the points being selected by Mr. CHAS. N. GOWAN, Division Engineer, who was also present at the trial. The aqueduct being here far below the surface, and no shafts being visible near the points selected, there was no possible clue to its location, more especially to a stranger, and yet at two of the three points a large body of flowing water was indicated with great exactitude as to location, though inexact as to depth. It is only fair to state that the day was most unfavorable, being the very reverse of what Mr. HEERDEGEN stated as a prerequisite for accuracy. The second tests were upon the old aqueduct in New York, and they resulted in an accurate determination in one case, and a slightly inaccurate one in the other, and here again the difficulty of getting a satisfactory artificially arranged test was apparent, as we discovered on making inquiries of the city water department, that the rock surrounding the aqueduct at this doubtful point was full of springs, which may have had a stronger influence upon the instrument than the artificially conveyed water in the conduit.

The foregoing tests were followed by an experiment rather than a test, which consisted in laying about 150 ft. of ¾-in. steam hose on the second floor of the Raub building, at the corner of Nassau and Fulton Sts., Mr. HEERDEGEN being stationed upon the third floor before the hose was uncoiled. This hose was passed through various rooms, a stream of water being sent through it, and Mr. HEERDEGEN succeeded fairly well in tracing upon the floor above its general direction and course. While not so satisfactory as to be conclusive, the test did certainly seem to indicate some power to follow the course of the water beneath. Still a third test, at which we were present, seemed very satisfactory and conclusive, the elements of uncertainty being eliminated as far as possible, the locality selected being outside the gate of the National Storage Co., near Communipaw, where the supply of water under pressure to these premises is large and entirely removed from all other pipes, drains, etc., and of course without any indication of its location. This pipe Mr. HEERDEGEN located with certainly wonderful accuracy and without hesitation, tracing it so nearly correctly that the engineer who had laid it some years previously, and who was present, stated that it was substantially correct. This case was one in which, allowing that Mr. HEERDEGEN had lit upon it at first only by chance or by a shrewd guess, it would have been almost impossible for him to have repeated that guess successfully three times at different points.

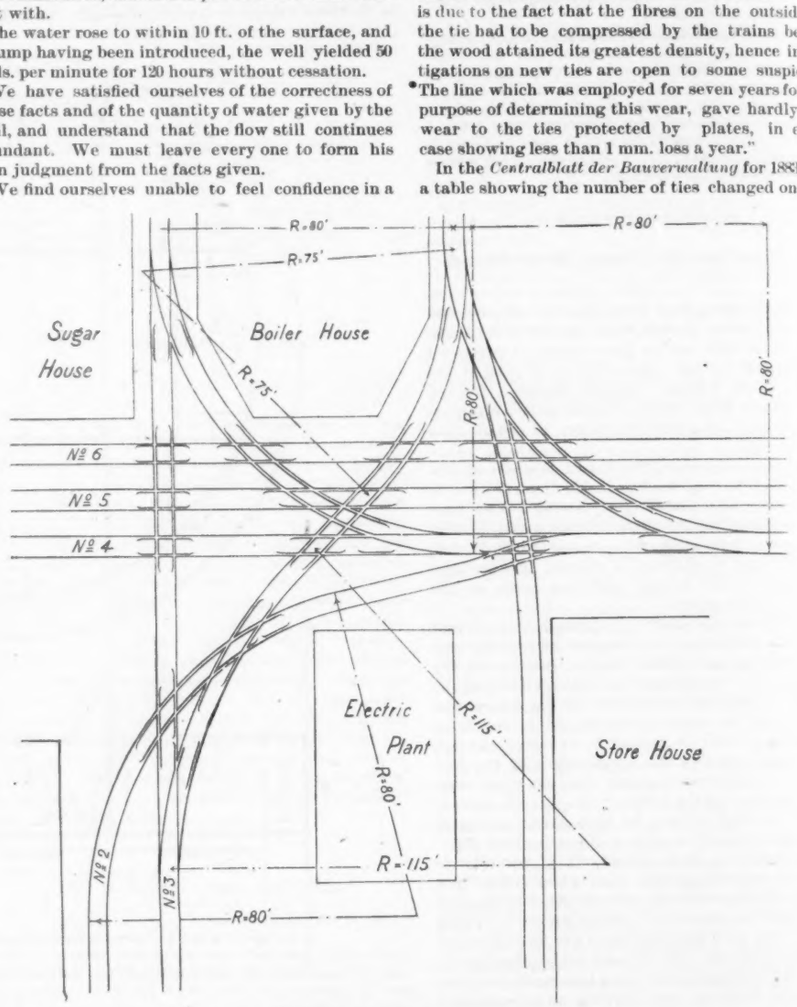
During the occurrence of these tests, a more practical opportunity was afforded to prove Mr HEERDEGEN's skill as a well-finder. Mr. ADOLPH G. HUFFEL, the brewer, at 161st St. and Third Ave., desired to have a well located at his brewery, where he had already drilled to the depth of 1,300 ft. without finding water. As related to us by Mr. HUFFEL, Mr. HEERDEGEN went over the ground in the neighborhood of the brewery with his instrument and discovered water on the west side of the property about 200 ft. off, and expressed his belief that it would be found within 30 or 40 ft. of the surface in considerable quantities, and that the stream was 20 ins. wide. Mr. HEERDEGEN traced the stream for about 1,000 yds., and pointed out in this distance four places where the same stream could be struck.

Having selected the place most convenient, boring was commenced, and at a depth of 31 ft. water was met with.

The water rose to within 10 ft. of the surface, and a pump having been introduced, the well yielded 50 galls. per minute for 120 hours without cessation.

We have satisfied ourselves of the correctness of these facts and of the quantity of water given by the well, and understand that the flow still continues abundant. We must leave every one to form his own judgment from the facts given.

We find ourselves unable to feel confidence in a method which is not fully explained, and yet it is but just to say that Mr. HEERDEGEN seems to be an entirely honest man, claims that his method and instrument have a scientific basis, and proposes to do business on the basis of guaranteeing water or no charge. Messrs. Heerdegen & Schnee have an office at 48 Exchange Place, in this city, and from them further information may be obtained. Various wells located by Mr. HEERDEGEN are now being bored, and we may be able later to give some further information on the subject.



A Complicated Crossing Plan.

German Experience with Tie Plates.

The following notes are taken from a paper on "The performance of rails with broad bases," by Prof. LOEWE, the leading German authority on such matters, according to Herr GLASER. We shall give later some further abstract of the contents of the paper, in relation to its main subject matter, rail sections.

SARRAZIN gave the first definite results of the use of tie plates, in the *Deutsche Bauzeitung* for 1877. He stated that on lines with considerable traffic, rails laid directly on the ties, cut into the wood at a rate of 6 mm. a year, while if they were laid on plates of twice the bearing surface of the rail-base, the amount of penetration was only one-half as much. Later and more careful investigations showed that the mean of 105 measurements on ties unprotected by plates, and of 105 measurements on ties so protected, gave these results: the rails laid directly on the ties, cut into the wood (fir), to a depth of 3.90 mm. in a year, and the rails with plates penetrated about 2.20 mm. Still later observations, recorded in the *Deutsche Bauzeitung* of 1880, show a still more favorable condition of affairs. "After seven years of observation, we may feel certain that the penetration of the tie plate into the tie, is much less than was at first believed. This is due to the fact that the fibres on the outside of the tie had to be compressed by the trains before the wood attained its greatest density, hence investigations on new ties are open to some suspicion. The line which was employed for seven years for the purpose of determining this wear, gave hardly any wear to the ties protected by plates, in every case showing less than 1 mm. loss a year."

In the *Centralblatt der Bauverwaltung* for 1883 was a table showing the number of ties changed on several lines in the course of six years, and the average life of a tie:

NUMBER CHANGED IN A YEAR.

	1877.	1878.	1879.	1880.	1881.	1882.
Oak ties.....	2,326	1,827	2,676	4,479	2,956	5,313
Fir ties.....	2,320	1,496	1,283	2,298	1,141	2,209

AVERAGE AGE OF THE TIES TAKEN OUT.

Oak ties.	13.8 yrs.	14.0 yrs.	14.3 yrs.	14.8 yrs.	14.8 yrs.	16.6 yrs.
Fir ties.	15.4 "	16.5 "	16.7 "	14.4 "	14.9 "	15.5 "

The unusual fact that the life of the oak is less than that of the fir ties is due to the fact that the oak ties were laid on the curves while those of fir were employed on the tangents. And the more rapid increase in the endurance of the oak ties is to be attributed to the fact that the tie plates were first employed on the curves; in 1880 about half the ties on the curves were provided with plates, while they were entirely wanting on the tangents.

A Complicated Crossing Plan.

The accompanying plan shows a curious melange of crossings recently constructed by the Johnston Railroad Frog & Switch Co., which sufficiently explains itself without many words of ours. Tracks 1, 2, 3 connect with the Pennsylvania R. R. at Swanson St.; tracks 4 and 5 connect with the Baltimore & Ohio; track 6 is for loading sugar. These six tracks necessitated 17 crossings, all within a space of about 100 ft. square; as many as we ever remember to have seen in so small a space.

The Paving Problem.

By request of the Board of Trade of Scranton, Pa., Mr. JAMES W. HOWARD, C. E., lately read a paper on "The Paving Problem," which is now published by the Board. There is much in this paper of decided interest on this important subject.

Omitting remarks on the necessity of good pavements, which all admit, Mr. HOWARD treats of the material of pavements. Commencing with wood, he says Chicago has proven that in less than nine years it is cheaper to use sheet asphalt or even the best granite blocks on a proper foundation than the wood pavement tried. London, with the best wooden pavements in the world, has to replace them in six years under moderate traffic and in four years under heavy traffic. The expense is much greater than for granite blocks. Noise is suppressed, but sheet asphalt is steadily replacing wood in the heart of London.

In speaking of macadam pavement, with a foundation 6 ins. or more deep and a wearing surface from 4 to 8 ins. deep, Mr. HOWARD arranged the best stone for the wearing surface in the following order:

(1) Dolorite, called also basalt or trap, which depends for its hardness upon the silica and feldspar in it; it has no true cleavage and breaks irregularly. (2) Syenite, a hard rock often passing for granite, and in the Eastern portion of the United States composed of quartz, feldspar and hornblende. (3) Granite, composed of quartz, feldspar and mica. (4) Limestone: few of them fit for macadam because of their softness. But a calcite, or compact limestone, makes an excellent roadway; is cheaper to crush at the quarry and cheaper to roll on the roadway. The cost of repair is, however, frequent and great. (5) Sandstone is useless for city streets and is only useful on country roads. (6) Shales, slates and other stones whose base is alumina, or clay, are totally valueless for macadam.

On cost of maintaining macadam, the author says that Waterbury, Conn., with 25,000 inhabitants, has spent $50,000 in seven years in keeping up gravel and macadam streets; Newark, N. J., has about the same experience. The official records of London, England, show that there are 1,127 miles of macadamized street surface in that city. The average cost of maintaining these, from fourteen reports, is $1,414,987 per year, or $1,212 per mile per year. In the inner city, where the traffic is very heavy, records extending from 1834 to 1870 show that the cost on seven streets has been 62½ cents per square yard per year. On twelve streets with a moderate traffic, covering 72,329 sq. yds., the repairs cost 29¾ cts. per yard per year. On 123½ miles of macadam, near the suburbs, and with the lightest city traffic, the maintenance cost 14½ cts. per yard per year. For the country roads of Islington Parish, used by the lightest but continual traffic of carriages, coaches, and rural teams, the cost of the whole 36 miles was 6¼ cts. per yard per year.

Paris began to replace its macadam with asphalt in 1854, and continues to do so steadily. But it yet pays nearly $900,000 per year to repair the macadam still in use. The maintenance of macadan in Paris costs about 45 cents per yard per year. Boston spends about 50 cents per yard per year; Berlin has abolished wood and macadam pavements; it now has much stone pavement of the best quality, and has increased its asphalt pavements at the rate of 12 per cent. per year for 17 years. Berlin is the cleanest city in Europe, and is made so at the least cost per yard.

The stone block pavement on Fifth Ave., New York, is a type of the best laid. It is placed on 6 ins. of concrete foundation, with a little sand, and then carefully cut granite blocks, 12 × 4½ × 7 ins., set on edge, and the spaces between the blocks filled with hot gravel and pitch. True granite makes the best paving blocks, and then come syenite, trap, and one or two sand-stones.

Mr. HOWARD concluded by discussing the question of pavements and health, and said that an impermeable pavement, was the only true sanitary pavement. An impermeable foundation of concrete or bituminous compounds is the first essential, and except for heavy trucking, where stone block, while the most costly, is the most durable, an unbroken, impermeable form of pavement is the most noiseless, least likely to harbor germs of desease, and is the best.

Elements of Weather in the United States, of Most Interest to Engineers, for the Month of February, 1890.

STATION.	Temperature. (Deg. Fah.) Average.	Max.	Min.	Range.	Wind. Velocity in miles per hour. Average.	Maxim.	Direction at time of max. velocity	Precipitation.—Rain and melted snow. Inches. Total.	Heaviest in 24 hours.	Number of rainy days.
NORTHERN CITIES.										
Northfield, Vt.	22.2	56	−7	63	12.4	48	N	3.20	1.05	14
Portland, Me.	26 6	58	0	58	9.8	43	S	4.04	1.58	16
New York City	40.4	69	17	52	12.0	45	SW	3.86	1.11	9
Pittsburg, Pa.	42.0	68	16	52	5 8	24	N	5.52	1.19	15
Chicago, Ill.	32.4	59	3	56	18.0	48	W	2.42	.53	12
Omaha, Neb.	25.2	64	−12	76	9.5	38	NW	0.54	.18	8
St. Paul, Minn.	18.5	51	−12	63	8.1	35	W	0.50	.13	10
Duluth, Minn.	16.6	52	−13	65	9.3	33	NW	1.09	.22	14
Bismarck, N. Dak.	4.1	46	−34	80	10.2	64	NW	0.27	.09	5
Average	25.3	58.1	−47	62.8	10.6	42.0	.....	2.39	0.73	11.4
SOUTHERN CITIES.										
Washington City	43.0	73	24	49	6.0	31	NW	4.20	1 69	15
Louisville, Ky.	46.4	73	22	51	6.7	33	SW	6.25	1 70	16
St. Louis, Mo.	40.2	78	4	74	12 0	37	SW	2.86	.82	12
Savannah, Ga.	61.4	80	38	42	7.5	27	NE	1.02	.41	7
Leavenworth, Kan.	32.3	70	−3	73	4.0	27	NW	0.54	.23	6
Jacksonville, Fla.	64.8	83	44	39	6.3	36	W	0.51	.33	6
Chattanooga, Tenn.	54.0	78	27	51	6.3	42	SW	7.85	2.02	12
New Orleans, La.	64.0	82	40	42	9.4	39	NW	2.27	0.79	5
Memphis, Tenn.	51.4	79	26	53	8·3	42	N	8.13	2.41	13
Palestine, Tex.	58.0	81	19	62	10.0	27	SW	4 95	1.49	10
Average	51.6	77.7	24.1	53 6	7.6	34.1	.....	3 86	1.19	10.2
WESTERN CITIES.										
Helena, Mont.	16.8	57	−29	86	6.1	60	W	0.82	.30	6
Port Angeles, Wash.	32.5	46	7	39	1.7	16	E	4 76	1.11	15
San Francisco, Cal.	49.1	64	36	28	7.3	36	S	5.16	1 63	12
Salt Lake City, Utah	33.7	58	− 6	64	5.8	26	S	2.05	.50	12
Denver, Col.	34.0	77	− 8	85	7.8	48	N	0.46	.28	7
Yuma, Ariz.	58.4	86	36	50	8.1	33	N	0.86	.71	5
Santa Fé, N. Mex.	36 5	67	6	61	9.1	36	NE	0.88	.30	9
Average	37.3	65.0	6.0	59.0	6.6	36.4	.....	2.14	0.69	9.4

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

Upper Coos.—It is stated that surveys will soon be commenced for an extension of this road, from North Stratford, N. H., via Brunswick, Maidston, Guildhall, Lancaster, and Jefferson, to Whitefield, N. H., where connection is made with the Maine Central R. R. Several routes will be surveyed in order to determine the most favorable line for the road. The length of the extension will be about 30 miles.

Lake Shore & Michigan Southern.—This company is pushing work on its second track across Indiana. Construction trains are now at work grading between LaPorte and South Bend, where some heavy work is to be done, and between Pine and Burdick stations. From Elkhart west there are now eight miles of double track; from LaPorte west 12 miles, and for one and a half miles east from LaPorte. Between LaPorte and South Bend the second track will be one mile shorter than the old track, through the taking out of several curves.

Gettysburg & Harrisburg.—It is stated that surveys will soon begin on the proposed branch of the Gettysburg & Washington R. R. to Baltimore, Md. It is expected that construction will soon begin on the main line from Gettysburg to Washington.

Sea View.—Work has been commenced on this road, which is projected to run from Wickford to Narragansett Pier, R. I., a distance of 8 miles. This portion of the road is to be completed by July 1. Next season it is intended to extend the line through Wakefield, Narragansett Heights and the Charleston farming district.

New York, Ontario & Western.—The Ontario, Carbondale & Scranton R. R., running from Hancock, N. Y. to Scranton, Pa., a distance of 54½ miles, is rapidly approaching completion. Track is already laid from Hancock to the Delaware River in New York, and the grading on the entire line is nearly completed. The road when completed will give the New York, Ontario & Western R. R. an entrance into the Pennsylvania coal fields.

Temiscouata.—This company asks a subsidy of $3,200 per mile in aid of the line from Edmundston to Moncton, N. B., 180 miles.

Toledo, Ann Arbor & North Michigan.—The company has filed a mortgage for $10,000,000. The object of the mortgage is stated to be as follows:

To provide for the cancellation of the series of divisional bonds; for the purchase of the Toledo, Ann Arbor & Lake Michigan R. R., and for the construction or purchase of such lines of railway as may from time to time be deemed necessary by the board of directors and stockholders; the establishment of a line of steamers and barges across Lake Michigan; the construction of the necessary docks and terminals on Lake Michigan; for the construction of additionals at Toledo, and for the purchase of the necessary rolling stock.

Philadelphia & Reading.—The surveys recently made for a connecting line between this road and the Elmira Courtland & Northern Ry. have been passed upon, and a route running from a branch of the P. & R. R. R. at Northumberland, Pa., through the Pine Creek coal region to Elmira, N. Y., has been decided upon. It is stated that bids are being received for the construction of the road and that work will soon begin. The scheme is to furnish the P. & R. R. R., an outlet to the New York Central & Hudson River R. R. It is proposed to improve the Elmira Courtland & Northern R. R. by double-tracking it, straightening the curves and otherwise improving the roadbed.

Projects and Surveys.

Westerly & Jewett City.—H. E. Chamberlain, of Westerly, R. I., has furnished us the following information concerning this enterprise:

The road is projected to run from Westerly, R. I., via Hopkinton, North Stonington, and Griswald to Voluntown, Ct., a distance of 25 miles. The surveys have been made and a very favorable route found. The work will be medium. There will be a 100 ft. bridge and a trestle 400 ft. long on the line. The route is through an agricultural and manufacturing country and the principal business of the road will be the local freight and passenger traffic. Nothing has yet been done toward securing the right of way or local aid for construction. It is expected, however, that a meeting of the Railroad Committee will be called soon and steps taken to push the enterprise. Thos. F. Chappell, of Pawtucket, R. I., is Chief Engineer.

Sault Ste. Marie & Hudson Bay.—We have received the following information concerning this enterprise from John A. Wilde, of Sault Ste. Marie, Ont., Chief Engineer:

The preliminary surveys for this road, which is projected to run from Sault Ste. Marie, Ont., nearly due north to the Messinaibe River, and following that stream to James Bay, a distance of 370 miles, have been completed from Sault Ste. Marie to the crossing of the Canadian Pacific R.R., a distance of 110 miles. The surveys for the remaining distance cannot conveniently be made until the opening of navigation. The profile of the route is roughly as follows: Starting from an elevation of 600 ft. above sea level at Sault Ste. Marie there is a rise of about 600 ft. to 1,000 ft. in the first 20 miles; thence for 120 miles the elevation varies from 1,200 ft. to 1,600 ft. above sea level, and from the 150th mile there is a gradual slope for the remainder of the distance to the terminus. The object of the road is to open up the country for colonization and to furnish an outlet for the timber and coal lands and fisheries of Hudson Bay. The right of way will be granted by the Colonial government. The company have just obtained its charter at the present session of the Canadian Parliament. Jas. Cozens is President of the company.

Hocking & Western.—A meeting of the stockholders of this company, whose incorporation was noted in our last issue, will be held at Circleville, O., March 31, to authorize the issue of $2,000,000 of bonds to aid in locating, procuring the right of way for, and constructing its pro-

posed line. The round is projected to run from Lancaster to Athens, O., 95 miles. G. R. Carr is Vice-President, and A. D. Knabenshue is Secretary, both of Columbus, O.

Lafayette Union.—Incorporated in Indiana to build a line of railway from a point southeast of Lafayette Junction to a point near Widewater, north of the City of Lafayette, a distance of seven miles. Among the directors are Edgar V. Burt, Samuel C. Curtis, Jas. Buck, and Wm. Ross.

Toronto Belt Line.—This company, noted in our last issue, has advertised for bids for the construction of its railway line. Address President Belt Line Ry., 82 King St., Toronto, Ont.

Baltimore Belt.—The bill incorporating the Baltimore Belt Line R. R. Co. has passed the Maryland Legislature.

Ottawa, Morrisburg & New York.—This company has been chartered in Canada to build a railway from Ottawa, Ont., to Morrisburg, Ont. The company also proposes to build a bridge from Morrisburg to Waddington, N. Y., and to extend the line ultimately to New York City.

Poughkeepsie & Hudson.—A correspondent writes us that this road is projected to run from East Park, N. Y., via Rhinebeck, Red Hook, Clermont and Blue Stone, to Livingston, N. Y., a distance of 41 miles. Surveys have been completed. The work is generally light, with some rock cutting; grades easy; maximum curve, 3°. The route is through an open farming country. J. O. Clark, of Syracuse, N. Y., is President, and E. H. Burlingame, of 477 Broad St., Providence, R. I., is Chief Engineer.

SOUTHERN.—Existing Roads.

Norfolk & Western.—The names and addresses of contractors to whom the work on the Ohio Extension of the Norfolk & Western R. R has been awarded are as follows, the miles covered by their contracts being numbered from the present end of track near Elkhorn, McDowell County, West Virginia:

Section	1— 30	Samuel Walton	Falls Mills, Va.
"	31— 50	E. S. Moorman & Co.	Lynchburg, Va.
"	51— 60	E. & J. Purcell	White Post, Va.
"	61— 70	E. A. Tennis	Thompsontown, Pa.
"	71— 100	Beckwith & Quackenbush	Washington, D. C.
"	101— 110	Ryan & Keemli	Wheeling, W. Va.
"	111— 120	Mason, Gooch & Hoge	Frankfort, Ky.
"	121— 130	Mason, Gooch & Rinehart	Frankfort, Ky.
"	131— 140	P. J. Millet	Paris, Ky.
"	141— 150	E. S. Whitney & Co.	Phillipsburg, N. J.
"	151— 160	Hugh Keogh	Lancaster, Penna.
"	161— 180	Paige, Carey & Co.	New York City.
"	181— 184	W. F. Patterson	Pittsburg, Penna.
"	185— 191	Mason, Gooch & Hoge	Frankfort, Ky.

The masonry for the Ohio River bridge, which will be for double track, has been awarded to W. F. Patterson, of Pittsburg, Pa. The superstructure had been previously awarded to the Edge Moor Bridge Works, of Wilmington, Del. The contract for cross-ties was awarded to E. A. Tennis.

Atlantic Coast.—The bill authorizing the consolidation of the Alexandria & Fredericksburg, the Richmond, Fredericksburg & Potomac, the Richmond & Petersburg, the Meherrin Valley and the Wilmington & Weldon railway companies into one organization, with the above name, announced in our last issue as before the Virginia Legislature, has been withdrawn.

Gulf & Chicago.—This company has advertised for bids for clearing, grading, bridging and furnishing cross-ties for a distance of 365 miles. S. D. Brown, of Mobile, Ala., is Chief Engineer.

Atlantic & Danville.—A press dispatch from Danville, Va., states that ground has been formally broken on the Danville & East Tennessee R. R. The branch from the main line, about 3 miles west of Clarksville, Va., to Buffalo Lithia Springs, Va., a distance of 3 miles, is nearly completed.

Cape Fear & Yadkin Valley.—Press dispatches state that this company is considering the early extension of its line from Bennettsville, S. C., south to Charleston, or some other point in South Carolina. About 400 men are now at work on the extension from Mt. Airy, N. C., north to the Virginia State line.

Georgia Southern & Florida.—Work, it is stated, will begin in a few days on the line from Tifton to Thomasville, Ga., a distance of 55 miles.

Ohio River.—The locating surveys for the Ravenswood, Spencer & Glendale R. R. have been completed, and it is stated that construction will commence early in May. The road is projected to run from Ravenswood to Spencer, W. Va., 25 miles. The route is through a rich portion of the State.

Darien Short Line.—It is stated that work will soon begin on the extension of this road north to Walthorville, Ga. The road is now completed from Darien north 11 miles, leaving 31 miles of line to be constructed. R. K. Walker, of Darien, Ga., is President.

Griffin, Monticello & Madison.—A press dispatch states that the prospect is good for the early completion of this road. About 25 miles of the line was graded some time ago and the work abandoned. The road will run from a point on the Covington & Macon R. R. via Madison to Griffin, Ga.

Roanoke & Southern.—The Virginia and North Carolina Construction Co. has taken the contract for building this line between Roanoke and Martinsville, Va. Work is to be commenced at once.

Georgia Midland & Gulf.—The report is in circulation that this company will build the projected extension from McDonough to Athens, Ga., at once. The road is now completed from Columbus to McDonough, Ga., 97 miles, and the extension to Athens would be about 98 miles.

Lynchburg & Durham.—The bridge across the Dan River is completed, and tracklaying south of that point is being rapidly pushed.

Norfolk & Western.—This company has let the following contracts for double-tracking its line from Roanoke to Radford, Va.: To E. J. Gaynor & Sons, of Pottsville, Pa., 14 miles; to Codweiss & Co., 10 miles; to John Killey, of Lynchburg, Va., 5 miles. All three contractors have large forces at work and expect to complete grading and masonry by Sept. 1.

Kentucky Midland.—There is talk of extending this road from Paris to North Middleton, Ky.

Projects and Surveys.

Georgia, Tennessee & Illinois.—This company proposes to build a line of railway from Tallapoosa, Ga., to Chattanooga, Tenn. The object of the road is to open up the timber and mineral lands along the route. Surveys are now in progress. L. F. Bellinger is Chief Engineer.

Basic City & West Virginia.—A bill is before the Virginia Legislature incorporating this company to build a railway from Basic City, Va., to the West Virginia State line. C. E. Hoge, C. E. Holt, Edward Echols and others are the incorporators.

Nashville & Mississippi Delta.—This company has applied to the Mississippi Legislature for a charter. It proposes to build a railway on the survey of the Vicksburg & Nashville R. R. Co., from Okolona to Houston, Miss. Among the incorporators are: J. M. Trice, Frank Burkett, J. W. Buchanan and others.

NORTHWEST.—Existing Roads.

Chicago, St. Paul & Kansas City.—A press dispatch states that the problem of this company's entrance into Kansas City has been solved. A company to be called the Leavenworth & St. Joseph R. R. Co. has been organized to build a railway from Leavenworth, Kan., to St. Joseph, Mo. Over this new road and the tracks of the Kansas City, Wyandotte & Northwestern R. R., now leased by the C., St. P. & K. C. R. R. Co. the company will obtain an entrance into Kansas City.

Great Northern.—It is reported that the contract has been let for grading the extension from Sioux Falls to Yankton, So. Dak., and that work will begin as soon as the weather permits.

Duluth & Winnipeg.—It is stated that the North Star Construction Co., which was recently chartered in New Jersey, has secured control of this road, and will immediately extend it to the International boundary. The construction company was organized to build railways, and to develope the Lake Superior ore lands. B. N. Baker, of Baltimore, Md., is President, and R. C. Munger, of Duluth, Minn., is Vice-President.

Sault Ste. Marie & Southwestern.—This road has now been graded to Mondovi, Wis., and it is announced that the track will be laid in a short time. N. C. Foster, of Fairchild, Wis., is President.

Projects and Surveys.

Mexican Railway Development Co.—This company has been incorporated in Illinois with a capital stock of $100,000, to build and equip railways. Among the incorporators are M. Masterson, W. A. Robinson and W. B. Wilson.

Kearney, Hutchinson & Gulf.—It is stated that the contract for surveying this road from Kearney, Neb., to the Kansas State line, has been let to George Cox, of Kearney, Neb. Surveys will commence at once.

Lincoln & Western.—Chartered in Nebraska to build a line of railway from Lincoln, Neb., west to the western boundary of the State.

Lincoln, Sioux City & Yankton.—Incorporated in Nebraska to build a line of railway from Lincoln to Covington, Neb.

Port Edwards, Centralia & Northern.—The contracts for building 14 miles of this road will be let April 1, and for the remaining 16 miles about May 1. The work will be pushed as rapidly as possible, and the road completed by Sept. 1. The road is projected to run from Port Edwards to Marshfield, Wis., a distance of 30 miles. J. E. Nash, of Centralia, Wis., is President.

SOUTHWEST.—Existing Roads.

Wichita Valley.—A correspondent writes us that about 5 miles of the grading on this road have been completed. The road will be 55 miles long, with easy grades and curves. The principal business will be in wheat, general merchandise, and cattle. Morgan Jones, of Ft. Worth, Tex., is President, and P. H. McCrickett, of Wichita Falls, Tex., is Chief Engineer.

Haines Medina Valley.—We have received the following information from C. D. Haines, of Castroville, Tex.:

The grading has been completed on this road, which is projected to run from Castroville to Lacoste, Tex., a distance of 7 miles. The work is quite heavy, there being ¾ miles of bridging and trestling, 2 miles of side-hill cuts, and 2 miles of gravel and rock cuts. The right of way has all been obtained, and about $20,000 of local aid secured. Haines Bros., the contractors, expect to begin tracklaying about March 20, and to have the road completed by April 15. It is the intention to extend the road ultimately about 75 miles south and 50 miles north. The company was chartered Feb. 12, 1890. Mrs. Charles D. Haines is President, and Owen Merriwether is Chief Engineer.

Texarkana & Northern.—It is announced that the money necessary to extend this road north from the Red River has been secured, and that work will be pushed. J. E. Dougherty, of Texarkana, Tex., is Chief Engineer.

Missouri Pacific.—The annual report of this company for the last fiscal year shows the following results from operations:

Gross earnings	$23,493,467
Operating expenses	15,532,883
Net earnings	7,960,584

Projects and Surveys.

Little Rock Belt.—This company has commenced the survey for its proposed belt line to open up the granite quarries around Little Rock, Ark. The survey is being made under the direction of Silas C. Martin, of Little Rock.

Halstead Belt Line.—Chartered in Kansas to build a railway from a point in Halstead township south to a point in McPherson County, a distance of 55 miles. Among the incorporators are: J. D. Lange, W. F. Gehner, J. Winkler and James Dow, all of Halstead, Kan.

Henrietta, Jacksboro & Gulf.—Organized in Texas to build a railway from Henrietta to Jacksboro, Tex. W. D. Stickney, of Henrietta, Tex., is interested.

Gulf, Brazos Valley & Pacific.—This company, whose incorporation was noticed in our issue of Feb. 22, proposes to build a railway from Velasco at the mouth of the Brazos River, northwest to Henrietta, Tex., a distance of about 400 miles. Contracts are reported let to Gurley, Ross & White, of Waco, Tex., for building 10 miles of the line. C. W. White, of Waco, is President.

Guthrie, Reno City & Fort Reno.—This company has been chartered to build a line of railway from Guthrie to Fort Reno, Ind. Ter., a distance of 42 miles. The officers are: President, A. Jennings; First Vice-President, J. W. McNeal; Second Vice-President, J. T. Sanders, Secretary and Treasurer, C. M. Keller, and Chief Engineer, C. J. Dubois.

Navasota, Anderson & Madisonville.—A project to build a railway from Navasota to Madisonville, Tex., 40 miles, is being agitated. Capt. E. B. Seay, of Madisonville, is interested.

Kansas City, Nevada & Ft. Smith.—General manager Richard Gentry is quoted as saying that the necessary material has been purchased for building this road from Kansas City to Monett, Mo., and that the contracts for construction would be let in 15 days. It is the intention of the company to have the road completed from Kansas City to Nevada by Aug. 1.

ROCKY MT. AND PACIFIC.—Existing Roads.

Seattle, Lake Shore & Eastern.—Press dispatches from Seattle, Wash., state that this railway has been absorbed by the Great Northern R.R. Co., and the name changed to the Seattle & Montana R.R. It is stated to be the intention of the Great Northern Co. to build a line from its present terminus at Helena to Spokane Falls, and complete the Seattle, Lake Shore & Eastern R.R. from its present terminus west of Spokane Falls, as originally projected. This will secure the Great Northern an outlet to the Pacific coast.

Seattle & Northern.—The contracts for the tracklaying on the northern extension of this road will be let at once. F. A. Hill, superintendent, Anacortes, Wash.

Union Pacific.—Parties of engineers are reported in the field running lines from Pioche, Nev., to various points in Southwestern California. Work on the line from Frisco, Utah, to Pioche is making good progress, and it is expected that the road will be completed by Aug. 1.

Ellensburg & Northeastern.—This company is asking bids for furnishing 104,000 ties for its road. Hubert C. Ward, Bostwick Block, Tacoma, Wash., Chief Engineer.

Santa Fé Southern.—It is stated that the capital necessary to build this road has been secured, and that work will begin soon.

Oregon & Washington Territory.—The announcement is made that work will soon begin on the location of the line from Walla Walla to Union, 120 miles. F. Riffle, of Walla Walla, Wash., is Chief Engineer.

Projects and Surveys.

Pacific, Chehalis & Eastern.—Chartered in Washington to build a railway from Willapa Harbor east via Chehalis to the Columbia River. Among the incorporators are: Jno. A. Chandler and Chas. A. F. Morris, of St. Paul, Minn., and John Dobson, Wm. M. Urquhart, and Daniel C. Milletts, of Chehalis, Wash.

Columbia & Carbonate.—This company is applying to the British Columbia Legislature for a charter to build a railway from a point on the Columbia River, near Golden, to the head waters of Copper Creek.

Fincastle & Southern Botetourt Development Co.—This company has been organized in Virginia to build a dummy railway from Fincastle, Va., to a connection with the the Shenandoah Valley Ry. The preliminary survey has been ordered and it is stated that the work will be pushed rapidly forward. The officers are: President,

Wm. R. Simmons; Vice-President, Lewis Hausman, Jr.; Secretary, Geo. Swann, and Treasurer, E. J. Brugh.

Sumter & Wateree.—Surveys have been completed for this road, which is projected to run from Sumter to Camden, S. C., 30 miles. Jas. D. Blanding, of Sumter, S. C., is President.

FOREIGN.

United States of Colombia.—A correspondent has furnished us with the following data concerning the various railways and other public works being carried on in the United States of Colombia:

The Barranquilla Ry. & Pier Co. is now operating the road from Barranquilal to Puerto Colombia, 17 miles, and handling about 80 per cent. of the freight of this country. The company will commence operating a steam street railway in Barranquilla as soon as the necessary rolling stock arrives. An English syndicate is about to build a short line south from Santa Maria. The Chief Engineer is Charles Cowperthwaite. There are some rumors of another English syndicate building a railway from Cartagena to Calamar, but it seems hardly probable that the line will be built, as it would not pay operating expenses. The State Government of Antioquia is gradually repairing and bettering its small road of 30 miles under the direction of Mr. Dougherty, who was Chief Engineer of the road for Mr. Cisneros when he built it. This road, when extended to Medellin, will be one of the best roads in this country. There is a railroad from Cucuta to San Buenaventura, on the Catacumbo River which is also a good paying road. The next important road is the Dorado, which runs from Yeguas to Honda, by which some rapids in the Magdalena River are avoided. Then follows the Girodot road, building under government direction. The "Savanna" road, running from Bogota north about 23 miles on the "mesa" of Bogota. Then the Buenaventura-Cali road, on the Pacific coast, which is only partly finished. In addition to the railway work a large amount of work is being done on the improvement of the Magdalena River.

Vanegas, Cedral & Rio Verde.—A press dispatch from Laredo, Tex., states that this Mexican railway has been purchased by C. F. Cook, of Vanegas, Mex., who will extend it 350 miles.

Hidalgo.—This Mexican company is receiving large quantities of material for the extension of its line to Tulancingo. Its bridge, 104 ft. long, to be placed over the Grand Drainage Canal, has arrived.

RAPID TRANSIT.

Electric Railways.—An electric railway is being built from Garfield, N. J., to Passaic and Clifton.

A company has been organized at Pittston, Pa., to build an electric railway 30 miles long from Wilkesbarre to Pittston and Scranton.

At Baltimore, Md., the North Ave. Ry. Co. has decided to adopt electric traction, and will have its road in operation by April.

The United Electric St. Ry. Co., of Nashville, Tenn., has been formed by a consolidation of the several companies. It owns 50 miles of track. President, T. W. Wrenn; Secretary, Frank Morrow.

An electric railway, four miles long, connecting East Liverpool and Wellsville, O., is projected by Alliance parties.

The North Side St. Ry. Co., of Minneapolis, Minn., has been incorporated by I. M. Moan, George P. Wilson and T. B. Walker. Capital stock, $500,000.

Cable Railways. The Johnstown Passenger Ry. Co., of Johnstown, Pa., has granted a perpetual lease to T. L. Johnson, of Cleveland, O., who proposes to build a cable road.

The St. Louis Ry. Co. will put in a cable system on the Broadway line, 7¼ miles long. Bonds for $1,500,000 have been taken by the St. Louis Trust Co.

The West Seattle Cable Ry. Co., of Seattle, Wash., has been incorporated by Thomas Ewing, H. G. Struve, and W. C. Hill, of Seattle, and Homer King, of San Francisco. Capital stock, $500,000.

Street Railways.—The Twenty-third St. Ry., and its Bleecker St. branch, New York City, have been purchased by the New York and Philadelphia syndicate which controls the Broadway line.

The Gravesend, Flatlands & Brooklyn Ry. Co. has been incorporated by Harry Osborne, of Gravesend, N. Y.; Michael J. Dady, John H. O'Rourke, and others, of Brooklyn. The road will be about 5½ miles long.

A street railway between Asbury Park and Belmar is projected. Mr. Bailey, Chief of Police at Asbury Park, is interested.

The City Council, of Pittsburg, Pa., has granted franchises to ten street railway companies. Most of the lines will be feeders to the Duquesne Traction Co.'s line.

At Goshen, Ind., a street railway is projected, and money is being subscribed for the project.

The Union Rapid Transit Co., of Springfield, Ill., has been incorporated by J. B. Kenner, J. J. Coffman and M. U. Bealey. Capital stock, $100,000.

The Cook County Passenger Ry. Co., of Chicago, has been incorporated by G. S. Dudley, J. N. Atchison and H. J. Reynolds. Capital stock, $100,000.

A street railway will be built at Vancouver, Wash., by the Pacific St. Ry. & Real Estate Co.

HIGHWAYS.

Missouri.—The County Court at Kansas City has issued an order redividing the county into road districts. The new law requires such division to be made by school districts, and by following these lines the boundaries of the road districts have been greatly changed. Where the school district was large and densely populated it was made by the court into a road district, but where several small school precincts were together in some instances as many as four were incorporated into one road district. The original number of road districts was 57, but by the change this has been decreased to 53. Under the law all incorporated towns are excepted, and this exception also contributes in some measure to the confusion in the lines of the newly-established districts. The court also spent a portion of its time in the discussion of the road improvement question.

Pennsylvania.—A discussion of the road question engaged the attention of a large gathering of farmers, supervisors and politicians at the County Agricultural Society, at Lancaster, March 3. Recommendations were made to the commission appointed by the last Legislature to revise the road laws in many respects.—At Reading the Highway Committee has asked for an appropriation of $95,000.

New York.—The committee of the citizens of North Hempstead who were appointed to visit Bridgeport, Conn., and inspect that city's system of building macadamized roads, have returned and rendered a report in favor of the 4-in. broken stone roads in use there. The cost is $3,000 per mile. The town will probably appropriate $40,000 this spring for the purpose.

Indiana.—The damage to the roads of Blackford Co by the recent heavy weather will be very great. An estimate of the damage to gravel roads and turnpikes places it at $75,000. The Bugle gravel road is ruined, and it cost $35,000. The Reasoner, just completed at a cost of $27,000, is also ruined. In fact, the pikes are in no worse shape than the gravel roads. In Hartford City the streets are in the worst shape they have been for years, the damage being not in faulty construction, but because of the unprecedented and continuous rainfall. What is true of this county is said to be true of every county in this section of the State.

Alabama.—The Court of County Commissioners at Birmingham has passed upon two petitions for new county roads and granted both applications. One of the roads will pass through East Birmingham from the corporate limits of the city and intersect the macadamized road at Woodlawn. The other goes out from Jonesville to a point on the Arkadelphia road near North Birmingham. Overseers have been appointed for each.

California.—A road connecting Santa Rosa with Occidental, to cost about $10,000, will probably be built this summer. It is being agitated by citizens of Santa Rosa and Occidental, and all but $1,200 of the amount has been secured.

Vermont.—The selectmen of Hinesburg have been appointed road commissioners and directed to ascertain the cost of a stone crusher, and the cost per mile of macadamized road.

WATER-WORKS.

NEW ENGLAND.

Cape Elizabeth, Me.—The town has voted in favor of establishing works. The town officials have voted to accept the following propositions made by the Portland Water Co.:

To lay about 8 miles of pipe in all the principal streets of the villages from Cash's Corner to South Portland; to put in 50 hydrants free and as many more as may be wanted at cost; drinking fountains for man and beast; the free introduction of water into school buildings and public buildings, all for $2,500 per annum for 12 years, after which it becomes the property of the town forever. The supply would be taken from Sebago Lake.

Bucksport, Me.—Parker Spofford, President, informs us that they expect to make extensions this year.

Old Town, Me.—We have received the following from H. T. Sparks, of Brewer, Me.:

Work was begun on a system of works, in a small way, last year, by the Penobscot Water & Power Co. Work will be resumed in the spring. The plans are not yet fully completed. The town has contracted for 60 hydrants for a term of 20 years. Mathew hydrants, and Eddy valves will be used. Water is pumped from the Penobscot River to a stand-pipe. President, F. H. Clergue; Secretary, M. H. Wardwell; Treasurer, F. M. Laughton, all of Bangor, Me.; Superintendent, H. T. Sparks, of Brewer, Me.

Concord, N. H.—About two miles of new mains are being laid.

Holyoke, Mass.—This year's improvements will include laying about two miles of new mains. Work will be resumed on the new reservoir about April 1.

Lenox, Mass.—The committee on water supply has reported a bill in the Legislature to authorize the Lenox Water Co. to issue additional bonds. It amends the law of 1887 so that the company may hold $65,000 worth of property, and the capital stock may be $75,000, and allows bonds to be issued to the amount of the capital stock actually paid in, to bear not over 6 per cent. interest.

Ipswich, Mass.—Surveys for a supply from several sources have been made by Engineers Farrington and Springfield, of Boston. Dow's Brook is recommended as a source of supply. Estimated cost, $16,455.20.

Brockton, Mass.—Superintendent W. F. Cleaveland informs us that about 10,000 ft. of 6 in., 1,500 ft. of 8 in., and 3,000 ft. of 10-in. pipe will be laid, and that 18 new hydrants, and 10 or 12 valves, will be set this year. Also that about 150 meters will be placed.

MIDDLE.

Warsaw, N. Y.—The town has contracted with the water company for fire protection and public fountains at $1,000 per year.

Norwich, N. Y.—Bids will be received until March 31 for constructing an additional reservoir, etc. W. S. Franklin is the Engineer.

Syracuse, N. Y.—The water bill authorizing the city to take its supply from Skaneateles Lake has been reported upon favorably in the House.

Jordan, N. Y.—The taxpayers will soon vote on the project of renting for fire purposes the 20 hydrants recently put in by the New York Pipe Mfg. Co., for fire protection. The supply has a capacity of 1,200,000 galls. The company has also laid about three miles of pipe. The company asks the town to pay $725 per annum.

Albany, N. Y.—It is reported that the special water committee has abandoned the driven well system for securing a new water supply, and that they will require Andrew Bros., the contracters, to refund the amount already paid them on their contract.

Orange, N. J.—The following recommendation is made by the Superintendent in his annual report, recently submitted:

I would, therefore, earnestly request the Water Committee to take some steps toward increasing our water system at once, and I would suggest that the land situated south of the dam, and known as the Watkins property, receive favorable consideration. It is the highest available ground in the immediate neighborhood whereby our water pressure can be sustained, and in my opinion is a place fitted by nature on which to build a reservoir.

Allegheny, Pa.—The Water Committee has awarded the contract for water pipe to the National Foundry & Pipe Co. at the following prices: 4-in., $26.40 per ton; 6-in., $24.80; 8-in., $14.80; branches, 2¼ cts. per lb.; sleeves, 2¼ cts. per lb. The Rensselaer Mfg. Co., of Troy, N. Y., was awarded the contract for supplying the valves at the following prices: 4-in., $7.50; 6-in., $12.45, and 8-in., $18.45. The Union Foundry & Machine Co. was awarded the contract for supplying miscellaneous castings. The contract for furnishing wooden boxes for the valves was awarded to Samuel Hastings. For furnishing pig lead, to Bailey, Farrell & Co. at $4.50 per hundred.

Freeport, Pa.—It is reported that C. M. Ludwig and others have purchased the plant of the water company at $12,000, and also leased the Prager Independent Water Line. Extensions and improvements will be made.

Olyphant, Pa.—Works are now being built by the Olyphant Water Co. Treasurer, G. T. Richards; Cashier, M. M. Bank, Scranton, Pa.

Pine Grove, Pa.—A. T. Felty informs us that he will probably begin work this spring.

Cumberland, Md.—The bill authorizing the Mayor and City Council to issue $70,000 of coupon bonds has passed the Senate and been signed by the Governor.

SOUTHERN.

Batesburgh, S. C.—The proposed source of supply is artesian wells. Address E. F. Strothers.

Fort Valley, Ga.—The company has closed a contract with Jennings & Bamberg, of Bamberg, S. C., to erect works. They are to be completed and in operation by the middle of the summer.

Waynesboro, Ga.—The town is to be furnished with artesian water by W. A. Wilkins.

Cedartown, Ga.—We have received the following information:

A vote was taken last summer on the question of building works, but nothing has yet been done. The town might contract with a company if satisfactory terms were offered.

Rising Fawn, Ga.—The following is from George W. Cureton:

A $10,000 system of works is being constructed by the Fox Mountain Water-Works, under the supervision of George W. Cureton. Water will probably be pumped from springs to a reservoir. The works will be put in operation about April 25. Population, 1,500.

Gainesville, Fla.—B. C. Drake has sent us the following:

The works will be built by the town. Money will be raised by taxation. Water will probably be pumped from artesian wells to a stand-pipe. Population, 5,000.

Uniontown, Ala.—We have received the following from J. A. Hudson, City Clerk:

Work will be commenced soon. Water will be pumped from a well, 950 ft. deep. The water will have to be purified.

Bridgeport, Ala.—Address the Bridgeport Land and Improvement Co., for information regarding the proposed works. Plans and specifications are now being prepared.

Decatur, Ala.—Extensions are being made by the company.

Jackson, Miss.—The Water Board, Mayor, and Aldermen, have passed a resolution to notify the water company that the water furnished is not as pure as the contract prescribed, and insisting that pure water be furnished hereafter.

Pass Christian, Miss.—We have received the following from John H. Long, President:

Water will be conveyed by gravity from 9 wells 2 to 4 ins. in diameter, direct to the mains. The work is being carried on by the C. P. Artesian Well Association, the East End Co. and the West End Co. President, John H. Long; Secretary and Treasurer, N. Butshert. Population, 1,600 to 3,000.

Lake Charles, La.—The proposition made by A. Munger & Co. to establish works has been defeated by a vote of the property holders.

Covington, Tenn.—D. B. Cummins has sent us the following:

A small system of works is to be established by the Covington Water-Works Co. President, R. M. Jockett; Secretary, J. R. Sloan; Treasurer, J. T. Garner; Manager, J. J. Green. The town will pay $125 per year for 5 fire hydrants. Water will be conveyed by gravity from a spring to a tank.

Hill City, Tenn.—Address J. B. Gordan, of Atlanta, Ga., for information regarding the projected works.

Newbern, Tenn.—J. Ira Jones, Secretary of the Water Committee, has sent us the following:

The subject of constructing works is being discussed, but nothing definite has been decided upon. Preliminary surveys have just been completed. Water will probably be pumped from tubular wells to a tank or stand-pipe. Population, 2,000.

Union City, Tenn.—Regarding the projected works, S. Waddell has sent us the following:

Contracts will be let soon. Several private companies are to make bids. The proposed plan is to pump water from wells to a stand-pipe. Population, 4,500.

Harrodsburgh, Ky.—J. H. Gautier, G. A. Curry or W. K. Cardwell may be addressed for information regarding the proposed works.

Mayfield, Ky.—The following is from Superintendent B. A. Neale:

Works are being built by the Mayfield Water & Light Co. President, L. Anderson; Secretary, D. P. Coulter. Contractors, Commonwealth Construction Co., of Philadelphia. Water will be pumped from deep wells to a stand-pipe. Estimated cost, $35,000 to $40,000.

NORTH CENTRAL.

East Palestine, O.—The new works will be put in operation about April 1.

Van Wert, O.—The bill authorizing the town to issue $25,000 of bonds has passed the Senate.

Norwalk, O.—The City Council has passed an ordinance to submit the proposition to bond the city for $75,000, to remove the water-works from the west end to the east end of the city, to a citizens' vote.

Lancaster, O.—The city proposes to construct a new reservoir on Mount Pleasant.

Crawfordsville, Ind.—A final decree has been filed in the U. S. Court, by Judge Gresham, in the suit of the American Loan and Trust Co., against the Crawfordsville Water-Works Co. It directs Master Fishback to sell the property for the benefit of creditors, unless the $170,000 owed the complainants is paid within 10 days. Ten thousand dollars earnest money must accompany each bid.

Greenfield, Ind.—E. W. Felt, Clerk, has sent us the following:

Contracts for constructing works were let last fall, but the City Council refused to approve of them. Nothing has been done since that time.

Huntington, Ind.—The city has granted a franchise to a home company for constructing works. Estimated cost, $120,000.

Romeo, Mich.—The question of establishing works has been defeated by a popular vote.

Imlay City, Mich.—The town has voted to issue $18,000 of bonds for building works.

Au Sable, Mich.—Superintendent J. S. Duncan informs us that they intend either to extend the suction-pipe further into the lake or to sink a large well.

Coldwater, Mich.—A vote on the question of issuing $75,000 to $100,000 of bonds for constructing works will be taken in April. C. D. Randall is Mayor.

Roscommon, Mich.—Works are being built.

Gaylord, Mich.—A system of works is being established.

Murphysboro, Ill.—W. K. Murphy, President, has sent us the following:

W. T. Stokey, of Belleville, Ill., is the contractor for the new works, to be completed July 1. Estimated cost, $120,000, including the electric light plant. They will be owned and operated by the Murphysboro Water, Electric and Gas Light Co. W. K. Murphy, President; Millard Wall, Secretary. Engineers, Johnson & Flad, of St. Louis, Mo. Water will be pumped from Big Muddy River to a stand-pipe.

Tuscola, Ill.—Works are being constructed.

Venice, Ill.—A petition has been presented by the City of East St. Louis asking for a franchise granting the right to lay mains through the streets, and offering to furnish water for hydrants free.—Another petition for the privilege to erect works has been presented by Dr. Youree, Theodore Seib and Mr. Thompson.

Sparta, Wis.—The Common Council has refused to submit the water-works question to a vote of the people.

Geneva, Wis.—Works are being constructed.

Ripon, Wis.—The following is from T. D. Stone:

Pipe is being received, and work will be commenced as soon as the frost is out of the ground.

NORTHWESTERN.

Guthrie Center, Ia.—Charles Ashton has sent us the following:

Nothing further has been done by the town than to vote to levy a tax. Population about 1,100. Water would probably be pumped to a tank. Estimated cost $9,000. No contracts have been made, and no bonds have been sold.

Blue Earth City, Minn.—We have received the following from George B. Kingsley, City Recorder:

The city intends to build works. Water has been secured in a well at a depth of 1,240 ft. Suggestions as to the best method to adopt are solicited.

Plainview, Minn.—C. D. Blanchard informs us that there has been some talk of establishing works for fire protection only.

Winona, Minn.—Petitions have been presented asking for a considerable amount of new mains.

Medicine Lodge, Kan.—D. J. Aber, Engineer, informs us that about two miles of extensions will be made.

Ainsworth, Neb.—The following is from W. H. Baldwin:

Work will be commenced on the new works as soon as the frost is out of the ground. Water will be pumped from wells to a stand-pipe. Estimated cost, $8,000. Population, 1,000

Mitchell, So. Dak.—At a recent meeting of the City Council an ordinance was presented and passed on the first reading, which provides for the sale of the water-works to F. R. Anson, of St. Paul, for $40,000, and also grants to the same party an exclusive franchise for 50 years. The ordinance is provoking general discussion, and will come up for final reading on March 13.

Madison, Dak.—Works are projected, the supply to be furnished from artesian wells.

SOUTHWESTERN.

Kansas City, Mo.—Before the city can adopt the plan outlined in our last issue for constructing, owning and maintaining its own works, it will probably be necessary to amend the city charter. An ordinance has been passed by the City Council providing for an election to vote on the question of issuing about $2,500,000 of bonds for providing works, the vote to be taken in April.

Lamar, Mo.—The City Council has accepted the proposition of A. H. Snyder to build works. A citizens' vote will be taken in 30 days to ratify the contract.

Neosho, Mo.—We have received the following from N. A. Morford, City Clerk:

W. P. Munro, of Nevada, Mo., has been granted a 20 years' franchise by the city. He has not submitted plans to the city as yet.

Fort Worth, Tex.—The City Council has passed an ordinance authorizing the issue of $150,000 of water bonds. Bids will be received until March 21 by A. W. Scoble, Superintendent, on blank forms which will be furnished upon application for the following material, f. o. b. cars at Fort Worth:

Cast-iron pipe: 190 tons 6-in. pipe, 33 lbs. per ft.; 224 tons 8-in., 50 lbs. per ft.; 241 tons 10-in., 65 lbs. per ft.; 103 tons 12-in., 82½ lbs. per ft., and 14 tons of specials. Hydrants: 45 fire hydrants, with 6-in. steamer connection. Valves: 12 6-in. gate valves with boxes; 6 8-in. gate valves with boxes; 4 10-in. gate valves with boxes; 1 12-in. gate valve with box; also 29,311 lbs. of lead and 1,777 lbs. of hemp packing.

El Paso, Tex.—The citizens have voted to issue $75,000 of bonds for constructing works.

Verona, Tex.—A company has been organized for the purpose of building water, electric light, and ice works. The capital stock is $60,000, of which $40,000 is already subscribed; the remainder is assured. The water supply will be drawn from a system of gang wells, in addition to which a deep artesian well will be sunk. The pump will have a daily capacity of 1,000,000 galls. Thomas & Gorman, of Houston, are the contractors. The works are to be in operation in six months.

Hubbard, Tex.—A stand-pipe, hydrants, mains, etc., are reported to be wanted by the Hubbard City Water Co.

Denver, Col.—The Galveston Land & Improvement Co. has been incorporated by J. B. A. Porter, F. P. Ernest and Charles Thurlow, with a capital stock of $2,000,000. The company will construct and operate electric light, water and gas works, wharves, etc.

New Castle, Col.—Sealed bids for the construction of a complete system of works will be received until March 24. Address A. Bondman, Jr., Town Recorder.

Boulder, Col.—The question of issuing $150,000 of 5 per cent. water bonds for establishing works will be decided by a citizens' vote on April 1. The plan proposed is to bring water from Camp Albion to Sunset, a distance of about 4 miles, in an open ditch; thence through 12 miles of 16, 10 and 8-in. pipe to a reservoir in Sunshine Cañon, 100 ft. higher than the present reservoir, and about a mile from town. The estimated cost is $137,668.

West Colfax, Col.—The West Colfax Improvement Association has contracted with the Mountain Water Co. to lay 1¼ miles of 8-in. pipe, and lay 6-in. cast-iron mains on West Colfax avenue, from the Boulevard westward 1¼ miles to the county line between Jefferson and Arapahoe counties, and set a hydrant every quarter mile, and one at the county line. The contract provides that these improvements shall be made and water furnished for a term of five years for $7,800. The officers of the Association are: President, Governor Loveland; Vice-President, Robert Ryan; Secretary, H. E. Pack. Engineer F. P. Arbuckle, of Denver, can probably furnish information regarding the work, supplies wanted, etc.

PACIFIC.

Seattle, Wash.—A statement of the pipe that will be required in connection with the large pumps recently ordered has been submitted, and the committee has decided it will be best to have the pipe laid before the pumps are put into operation. The following quantities will be required:

525 tons of 20-in., 175 lbs. per ft.; 500 tons of 16-in., 125 lbs. per ft.; 160 tons of 12-in., 80 lbs. per ft.; 29 tons of 8-in., 45 lbs. per ft.

West Seattle, Wash.—The West Seattle Electric Light and Water Co. has been incorporated at Olympia. Capital stock, $100,000. The Trustees are Thomas Ewing, H. G. Struve, W. E. Bailey, W. C. Hill, W. H. Llewellyn and G. B. Walker.

Anacortes, Wash.—The contract for building the new works for the Improvement Co. has been awarded to Theodore Warford, of Seattle.

Colville, Wash.—We have received the following information from John B. Slater:

Contracts will be let about May 15 by the Spring Mountain Water Co., for works to be completed in November. Work will be commenced about June 1. President, John B. Slater; Vice-President, J. M. Buckley; Treasurer, J. H. Young; Secretary, E. J. Roberts. The estimated cost is $15,000. Water will be conveyed by gravity from Spring Brook, about 5 miles distant, to a reservoir near the town; thence it will have a 248-ft. head, and be delivered direct to the mains. E. J. Roberts is the Engineer.

La Grande, Ore.—A contract has been let for sinking a well to a depth of 1,000 ft.

Independence, Ore.—A new water and electric light company has been organized, and applied for a franchise to build works.

Grant's Pass, Ore.—The following information is from F. M. Johnson, Superintendent:

The Grant's Pass Water, Light and Power Co. will construct works costing $30,000. William Knox, of Haywards, and F. M. Johnson, are members of the company. Water will be pumped from Brogue River to a reservoir, to be located near, and 150 ft. above, the town. Population, 2,200.

CANADA.

Chatham, Ont.—A bill is before the legislature to confer power upon the water company to borrow $150 000.

Toronto, Ont.—Superintendent Hamilton in his report to the Water-Works Committee recommends that the 4,000,000-gall. Worthington pumping engine at the station be replaced by a pump having a daily capacity of 8,000,000 galls.

Ottawa, Ont.—A bill has been introduced into the legislature to authorize the town to issue water bonds.

Galt, Ont.—I. G. Dykes, Town Clerk, informs us that the Water-Works Commissioners have not arrived at any definite conclusions as yet.

PROJECTS.

Columbia, Ala., M. S. Smith, Mayor. Rose Hill, Ga., F. D. Peabody, of Columbus, Ga. Parkersburg, Ia., Town Clerk. Fork, Me., Berwick Water Co.

ARTESIAN WELLS.

Buffalo Gap, Dak.—A well is being sunk.

Hawthorne, Nev.—A movement is on foot to sink a well.

Napoleonville, La.—At a recent meeting of the Town Council an ordinance was adopted to contract for an artesian well.

IRRIGATION.

Bear River City, Utah.—The Bear River City Irrigation Co. has filed articles of incorporation. The object of the company is to take water from the Malad River for irrigation in Box Elder County. Headquarters of the company are at Bear River City. The capital stock is $25,000.

Cheyenne, Wyo.—The Battle Creek Ditch Co. has been incorporated. The ditches to be made, and the requisite dams, flumes and works to be constructed, are situated on the west fork of Battle Creek, in Carbon County, and also on Little Sandstone, a tributary of Savory Creek, and along the Mesa Irrigating Canal.

Las Animas, Col.—Articles of incorporation of the Bent-Otero Improvement Co. have been filed at Denver. The object of the company is to build, construct and operate irrigating canals. Capital stock, $50,000.

Fresno, Cal.—The Alta Irrigation District has purchased the "Seventy-six" Land and Water Co.'s canal for $400,000. The company accepts the district's bonds at par in payment, and donates to the district the sum of $85,000, with which to buy back water rights already sold by the company.

SEWERAGE AND MUNICIPAL.

Sewerage.—The Common Council of Providence, R. I., has voted to apply to the Legislature for an act which will put the building and maintenance of sewers under the control of the Council. City Engineer Gray has presented plans and specifications of the improved sewerage system for the building of sewers in sections 3, 5, 6, 7, 8 and 9 of the Elmwood division, and in sections 10, 11 and 13 of the Allens' Ave. division, together with specifications for brick and cement.

At Ware, Mass., there are 10,000 ft. of the new system of sewers yet to be completed on the south side of the Ware River. Of the $50,000 voted to complete the work $17,000 has been expended.

Justice Cullen has decided the sewer case in favor of the village of White Plains, N. Y., and the work of finishing the construction of the sewers will now go on without further interruption.

At Elmira, N. Y., it is proposed to issue bonds for $500,000 for sewers.

The Sewerage Committee of East Orange, N. J., reports 400 house connections and 6,000 ft. of main sewers, a new pumping station erected on Springdale Ave. and the Montclair branch of the Morris & Essex R. R., and experiments disposing of the residuum of the sludge at the

disposal works by burning. It recommends extending the system as it becomes necessary, but only as fast as the present bonded debt is paid. The disposal works have been satisfactorily operated during the past year.

At Philadelphia, Pa., the Council has passed an ordinance authorizing an issue of bonds for $4,000,000 for public improvements, including main sewers.

A sewerage system is to be built at Henderson, Ky. Bonds for $50,000 will be issued.

At Columbus, O., it is proposed to issue $250,000 in bonds for a sewer and sewage pumping station.

Plans for a new sewerage system at Milwaukee, Wis., have been made by Thomas J. Whitman, of St. Louis, Mo.

A sewerage system is to be established at Lawrence, Kan. Plans have been adopted.

At New Castle, Pa., about 3 miles of sewers on the Waring system have been in use for 18 months and no obstructions have occurred. Contracts have been let for 1½ miles of extensions. A similar system is projected at Butler, Pa.

Mr. Geo. S. Pierson, City Engineer of Kalamazoo, Mich., in his recent report, says of the Waring system of sewerage: "The entire system has continued to operate satisfactorily throughout the year. There has been no stoppage in any of the mains or laterals which has made it necessary to excavate. A few partial stoppages have been removed without difficulty by a hose or by cleaning rods in manholes or lamp holes. The entire cost of maintenance of the system for the year is $146.68, and the entire cost of repairs, $41.65. The sewerage system, as inaugurated in 1880, has now a total extent of 12.77 miles, exclusive of connecting sewers. This system was built at a total cost of construction, proper, of $69,595.41, an average cost per foot of $1.032."

Gas Works.—An application has been made by C. O. French, solicitor for the Utah, Nevada & San Francisco Ry Co., to the City Council of Salt Lake City, for a franchise to construct gas works and lay mains in this city, the object being to supply light and heat, though principally the latter. The gas will be made from bituminous slack, and will be much cleaner for heating than coal. If he is successful in obtaining the franchise a company will be organized and work will begin at once.

Street Cleaning.—City Works Commissioner Adams, of Brooklyn, N. Y., has awarded the contract for cleaning the streets and removing the ashes during the three years beginning April 1. He has rejected the lowest bid, that of John Cassidy & Co., and given the contract to Cranford & Valentine, who were second lowest for street cleaning and fourth lowest for the removal of ashes. The contract figures of Cranford & Valentine are as follows: Street cleaning, $22.75 per mile. Removing ashes, first year, $140,000; second year, $144,000; third year, $148,000. Total, ashes, $432,000.

The bid of Cassidy & Co. was as follows: Street cleaning, $20 a mile. Removing ashes, first year, $125,000; second year, $135,000; third year, $139,000. Total, ashes, $399,000.

The second lowest bidder on ashes was John H. O'Rourke, at $420,000 for three years. The third lowest on ashes was Edward Freel, at $424,000. The other bidders were Daniel O'Connell, streets, $24.20 a mile, and ashes, $441,850; and O'Brien & Clark, streets, $23.95, and ashes, $455,000. On the basis of 12,000 miles a year the total amount of Cranford & Valentine's bid is $1,251,000; Cassidy's, $1,119,000. Difference, $132,000.

Street Work.—The Commissioner of Public Works, New York City, has prepared estimates for the second expenditure of $1,000,000 authorized by the Legislature for repaving:

Granite blocks on concrete foundation; area, 102,000 sq. yds.; estimated cost	$459,000
Asphalt on concrete foundation; area, 67,230 sq. yds.; estimated cost	301,170
Asphalt on present stone block pavement; area, 49,280 sq. yds.; estimated cost	197,120
Total area, 218,510 sq. yds.; estimated cost	$957,290

City Treasurer Neilson, of New Brunswick, N. J., has submitted to the Common Council a plan for the improvement of the streets of the city. For several years extra appropriations have been made for the repaving of different streets, and the residents of other streets have also taken up the matter, and by agreeing with the city to pay half the cost, have secured the pavement of their streets. By the City Treasurer's plan the city will itself undertake a systematic scheme of repavement, paving a certain number of miles each year. It is probable that an appropriation for beginning the work will go in the spring budget.

A new plan is being introduced in McKeesport, Pa., for the paving of wide streets. Union St. was laid out 60 ft. wide, much wider than necessary. To pave it in the usual manner would prove too expensive. A plan is being arranged to pave a roadway of 24 ft., leaving 18 ft. of side walk on each side of the street. Of this 5 ft. next to the properties and 5 ft. next to the curb will be sodded, and the other 8 ft. paved for sidewalk purposes. Shade trees will be placed along each side of the street.

It is proposed to lay asphalt paving on Washington St., at Indianapolis, Ind.

A council committee will go from Belleville, Ill., to examine the street pavements at Springfield and Decatur.

At Alton, Ill., there is a movement in favor of systematic paving of the streets.

At Los Angeles, Cal., a vote will be taken this month on the issue of bonds for $1,500,000 for a system of sewers, an outfall sewer to the ocean, and a system of storm sewers.

ELECTRICAL.

Electric Lighting.—A bill has been introduced to authorize the city of Frederick, Md., to add an incandescent plant to its electric light system. For particulars address the mayor.

The Volta Eclipse Electric Light & Power Co. has been incorporated at Washington, D. C. President, John Chester; Secretary, Frank Aldrich.

An electric light company has been organized at Bridgeport, O., composed of Ross J. Alexander, J. C. Dent, Eli Gilmore, Dr. John Cook and C. J. Heinlein. They intend to build an electric light plant that will cost about $10,000. Their bid to furnish the town with 25 arc lights at $82 per year each was accepted by Council.

Mansfield, O., has an electric light plant and also an incandescent plant, but a company of local capitalists has asked the City Council for a franchise for an arc and incandescent plant, agreeing to give for it 2 per cent. of the net profits of the company for ten years.

The Common Council of Bay City, Mich., has resolved to invite bids for furnishing the city with an incandescent electric light plant; also for bids from the local companies for furnishing the different city buildings with lights.

The Illinois Electric Service Co., of Chicago, Ill., has been incorporated by G. E. Spear, A. W. Reese and A. J. Price. Capital stock, $2,000,000.

The West Seattle Electric Light & Water Co. has been incorporated by Thomas Ewing, H. G. Struve, W. H. Llewellyn and W. C. Hill, of Seattle, Wash., and G. W. Prescott, of San Francisco, Cal. Capital stock, $100,000.

The Decatur Electric & Ice Co., of Decatur, Tex., has been incorporated. President, H. H. Haisell; Secretary, S. A. Lillard.

Train Lighting.—The Jordan Electric Train Lighting Co., of Boston, Mass., has been incorporated. President, W. S. Hill; Treasurer, John F. Wood; General Manager, L. F. Jordan. Capital stock, $500,000.

The Heisler Electric Light Co., of St. Louis, Mo., has shipped complete plants for long distance incandescent lighting to the cities of Durango and Aguas Calientes, Mexico. On account of the high cost of fuel the steam plants will be compound, condensing, high speed engines. The company reports a number of recent contracts for its long-distance incandescent apparatus; also additional orders from companies already using Heisler plants.

BRIDGES, TUNNELS, AND CANALS.

Bridges.—*Edmundston, N. B.*—The contract has been let for the masonry for the 150 ft. iron bridge being built at this place by the Temiscouata Ry. Co., and bids are now asked for the superstructure. R. A. Davy, Chief Engineer, Riviere du Loup, P. Q.

Grand Narrows, N. B.—It is expected to have the large bridge at this place being built for the Cape Breton Ry. Co., completed by July 1. The structure is 1,700 ft. long, with 7 spans, built in 72 ft. of water. The substructure is completed and a greater part of the work on the superstructure has been finished.

Ottawa, Ont.—The bill incorporating the Montreal Bridge Co. has passed the Dominion Parliament.

New Haven, Conn.—The following bids were received for the Rock Lane arch, steel bridge, 84 ft. span at this place:

Berlin Bridge Co.	$3,192
King "	3,942
Canton "	3,480
Penn "	4,050
Groton "	4,200
Pittsburg "	3,900
Boston "	3,908
Edge Moor "	4,610
Pencoyd "	3,713
J. W. Harry "	5,500
B. F. Hawkins Bridge Co.	3,500
Vermont Construction Co.	3,690
J. E. Buddington	4,224
Millikin Bros.	4,338

The contract was let to the Berlin Bridge Co., of East Berlin, Conn.

Shelton, Conn.—The Housatonic R. R. Co. will erect an iron bridge across the Housatonic River at this place to replace the present trestle. The structure will be 1,500 long, 5 span, and resting on masonry abutments.

Ausable Chasm, N. Y.—The 380-ft. iron bridge being built by the Delaware & Hudson Canal Co. over Ausable Chasm, on the Keesoville, Ausable Chasm & Lake Champlain R. R., is about half completed.

Middle Granville, N. Y.—The township of Middle Granville, N. Y., has appropriated $4,500 to build an iron bridge.

Tuscarora, N. Y.—The Rochester Bridge Works, of Rochester, N. Y., are building a 95-ft. iron bridge at this place for the Western New York & Pennsylvania R. R.

Wilmington, Del.—The following bids were received for the bridges across the cut which is being made from Chincoteague Bay to Indian River: W. J. McNatt, Georgetown, for Jefferson Creek bridge, $772; for Cedar Neck bridge, $695; for Beech Road bridge, $616. Colin McLane, New York, Cedar Neck bridge, $550; Beech Road bridge, $430; Jefferson Creek bridge, $500. West & Thompson, Ocean View, Cedar Neck bridge, $675; Beech Road bridge, $775; Jefferson Creek bridge, $635. William H. Virden, Lewes, Cedar Neck bridge, $335; Beech Road bridge, $365; Jefferson Creek bridge, $493.

Warren, Pa.—The Union Bridge Co., of New York City, is building a three-span steel bridge, 527 ft. long, for the Western New York & Pennsylvania R.R. at this place.

Chicago & West Michigan Ry.—The work on the bridge across the Big Manistee River, Michigan, for this railway is making satisfactory progress. The bridge is 1,370 ft. long, resting on masonry piers, and will consist of 1,220 ft. of trestle work and an iron span of 150 ft. About 450 ft. of the structure from the south end have been completed.

Chatham, Va.—The board of supervisors has decided to build bridges across Sandy River, at Stoney Mills and at Fitzgerald's Mills.

Fredericksburg, Va.—C. J. Watson, of Richmond, Va., Civil Engineer, is making surveys for the proposed bridge across the Rappahannock River at this place.

Wheeling, W. Va.—The Wheeling Bridge Co. has awarded the contract for building the 4-span bridge across the Ohio River to Martin's Ferry, O., to Ferris & Kauffman, of Pittsburg, Pa., for $452,000. The structure is to be completed in 10 months.

Wheeling, W. Va.—It is stated that the Cleveland, Loraine & Wheeling R. R. Co. will build a bridge from Martin's Ferry, O., to the "Island" opposite Wheeling, W. Va., during the present season.

Geneva, Ala.—The bridge over Double Bridges Creek, recently burned, will be rebuilt. The County Clerk of Geneva Co., Ala., can give information.

Knoxville, Tenn.—The Knoxville Southern R. R. Co. has completed plans for the construction of a railway bridge across the Holston River. A. A. Arthur, of Knoxville, Tenn., can give information.

Minneapolis, Minn.—The contract for the substructure of the proposed bridge over Minnehaha Creek has been let to Ring & Tobin, of Minneapolis. The prices are: Masonry, $6.50 per cu. yd.; concrete, $4.50 per cu. yd., and earth excavation, 50 cts. per cu. yd. There were nine bids for the superstructure, and four of the lowest will be considered.

Minneapolis, Minn.—The city engineer will soon advertise for proposals for constructing the bridge across the tracks of the great Northern R.R., on Fifteenth Ave.

Los Angeles Co., Cal.—Bids are asked for repairing a bridge over the San Gabriel River, at Sanford Crossing. Chas. H. Dunsmore, Clerk of Board of Supervisors' Los Angeles County, Cal.

Tunnels.—*New York, N. Y.*—The American Tunnel Construction Co. has entered into a contract to complete a tunnel under the East River, from South Sixth St. in Brooklyn, to Broome St., New York. The tunnel is to be operated under the Henning gravity transit system.

Canals.—The question of constructing a canal from Lake Huron to Black River will be submitted to the people of the city at the coming spring election on April 7. The estimated cost is $75,000.

The Atlantic, Mexican Gulf & Mississippi River Canal Co. is to be incorporated to build a barge canal from New Orleans to the Atlantic coast. Capital stock, $10,000,000. Cost estimated at $6,500,000. The incorporators are: Albert Pike, Marcus J. Wright, John B. Clark, Hernando D. Money, Philip D Roddey, Lafayette McLaws, Geo. H. Bier, Richard H. Musser, Jas. L. Bradford, John G. Fletcher, Fayette Hewitt, Robert T. Miller, Edward C. McDowell, Jos. Shepard, Robert D. Johnston, P. W. White, Luther S. Pike, Arthur S. C. Denver, Oscar Hindich and John Paxton.

A bill has been introduced at Annapolis, Md., to incorporate the Allegheny & Tidewater Canal & Transportation Co. to purchase or lease the property and franchises of the Chesapeake & Ohio Canal Co.

Bradbury & Bray, contractors for the construction of the Phyllis Canal and the Main Canal, along Snake River Valley, Idaho, announce that 500 teams and sub-contractors and 1,000 laborers are wanted at once to begin work on this enterprise. Information can be obtained from J. M. Bray, general office, Nampa, Idaho, and Harry Bruce, Union Depot, Ogden, Utah.

CONTRACTING.

Stone.—At Baltimore, Md., contracts have been awarded as follows: To furnish ashlar and rubble stone and coping for Boston St. bridge, to John Curley, at $6 per cu. yd. for ashlar, $3.50 per cu. yd. for coping, and for rubble stone $4.50 per cu. yd.; for iron gutter-plates for the remainder of the year, to Campbell & Zell Co., at 1 3 16 cts. per lb.; for cobble and gutter stones for repairs of paved streets to James H. Atkinson, at $1.30 per perch for cobble stones, and to John Harris for gutter stones at 15 cts. per lin. ft., and flagstones and Belgian blocks to go between the rows of flagstones, to James H. Atkinson for 20 cts. per sq. ft. for flagstones, and $1 per sq. yd. for the Belgian blocks.

Public Buildings.—At St. Augustine, Fla., the commissioners propose to erect a new jail.

Bonds for $100,000 for a new court house at Beatrice,

Neb., have been sold for $107,029. Work on the structure will begin at once.

Particulars in regard to competitive plans for a city hall at Quebec, Canada, may be obtained of Chas. Baillarge, City Engineer.

The Board of County Commissioners, Wheeling, W. Va., propose to erect a county jail at a cost of $20,000.

The Supervisors at San Francisco, Cal., will probably build a new jail.

E. E. Myers & Son, architects, of Detroit, are preparing plans and specifications for the new State Capitol at Salt Lake City, which is to cost $1,000,000.

Sewers.—Contracts have been awarded as follows by Ernest Adam, City Surveyor, Newark, N. J.: Second St. sewer, P. H. Harrison, 75 cts. per ft. for 12-in. pipe, $95 each for receiving basins, $28 each for manholes; Thompson St., P. H. Harrison, $1 and 75 cts. for 15 and 12-in. pipe, $96 for basins, $29 for manholes; East Kinney St., James Maguire, 47 cts. for 12-in. pipe, $95 for basins, $20 for manholes; Bedford St., P. H. Harrison, 75 cts. for 12-in. pipe, $28 for manholes; Fourth St., P. Harrison, 85, 75 and 65 cts. for 15, 12 and 10-in. pipe, $95 for basins, $29 for manholes; Third St., 80 cts. for 12-in. pipe, $28 for manholes; Elm St., 69 and 51 cts. for 15 and 12-in. pipe, $97 for basins, $23 for manholes.

Dredging.—At Providence, R. I., a bill has been passed for dredging and improving the harbor.

Road Roller.—The Park Commissioners, Boston, Mass., have received the following bids: Wm. C. Oastler, New York, $1,000 (Aveling & Porter roller); Harrisburg Car Mfg. Co., Harrisburg, Pa., $4,700.

Street Work.—The City Commissioner, Brooklyn, N. Y., has received the following bids for flagging: John Morrissey, 32 cts. per sq. ft; J. W. Moran, 23 cts.; Michael Mullady, 20 cts.

At Albany, N. Y., only one bid was received for the paving of Central Ave., from Watervliet to Main Aves., with Trinidad asphalt, and that was from the Barber Asphalt Co., as follows: asphalt pavement per sq. yd., including about 11,000 yds. of excavation, $3.25; new curb per lin. ft., 20 cts.; circular curb per lin. ft., 20 cts.; repairs for four years, $2 per sq. yd. The contract was awarded to the Barber Co.

Dams.—The Ogden Power Co., of Ogden, Utah, has let the contract for its entire work to Peter Wilson. The cost of two dams, a power house and superintendent's residence will be about $101,000. President, C. E. Wayne; Secretary, O. D. Banks. Capital stock $250,000.

Street Work.—The following proposals have been received by W. F. Erwin, Clerk of Board of Public Works St. Paul, Minn. The totals were as follows: Jas. Forrestal, $19,032.50; A. Anderson, $19,575.50; Portland Stone Co., $20,937 50; John C. Hill, $21,925; Carl H. Park, $20,766.67. The contract was awarded to Jas. Forrestal.

	Jas. Forrestal.	A. Anderson.	Portland Stone Co.	Theo. L. Morgan.	John C. Hill.	Carl H. Park.
	$	$	$	$	$	$
Cement block walk, hexagonal.....per sq. ft.	.18¾	.18½	.19¾	.18¾	.20	.19
Cement block walk, square..... "	.19¼	.18½	.19¾	.18¾	.20	.19 1-3
Granite curb-stone.....per lin. ft.	.85	1.10	.75	1.00	.90	1.00
Granite curb-stone, corners..... "	1.00	1.50	1.50	2.00	1.45	1.50
Re-setting curb, including repairing pavement where disturbed..... "	.10	.10	.20	.10	.22	.10
Rubble masonry, laid in cement.....per cu. yd.	1.00	3.40	3.50	3.25	4.00	3.50
Dry rubble masonry..... "	1.00	2.50	2.60	3.00	3.00	3.00
Brickwork.....per 1,000	10.00	11.80	10.00	12.00	15.00	16.00
Earthwork..... per cu. yd.	.24	.28	.35	.25	.40	.40
Rock excavation..... "	.30	.05	1.00	.80	.90	1.00
Railroad iron.....per lb.	.01	.01¼	.02	.01	.02½	.02
Wrought iron..... "	.06	.04	.04½	.06	.05	.06
Concrete under crossings and elsewhere.per cu. yd.	.80	3.00	4.00	3.50	5.25	4.00
Pine block paving (driveways)..... ...per sq. yd.	1.30	1.20	1.50	1.30	1.60	1.50
Re-laying cement block walk..... "	.10	.07	.12½	.08	.15	.10
Cutting " " " .....per lin. ft.	.08	.05	.10	.01	.10	.10

PROPOSALS OPEN.

Pipe.—Cast-iron water-pipe, 5 tons of 4-in, 450 tons of 6-in., 145 tons of 8-in, 90 tons of 12-in., 10 tons of 20-in. John A. Coleman, Commissioner of Public Works, Providence, R. I. March 18.

Dredging.—At foot of Vestry St., North River, 14,300 cu. yds; at East 28th St., East River, 1,100 cu. yds. The Docks Commissioners, Pier A, North River, New York City. March 19.

Street Work and Stone.—Regulating, grading, flagging and curbing. Also 15,000 lin. ft. of bridge stone. The Commissioner of Public Works, 31 Chambers St., New York City. March 20.

Brush, Etc.—Stone and edgings or brush fascines; pine timber, plank, drift bolts, spikes, stone, etc. Col. Wm. Ludlow, U. S. Engineer Office, Grand Rapids, Mich. March 20.

Pipe.—Cast-iron water pipe, 25 tons of class B 12-in., 47 tons of C 16-in., 930 tons of B 24-in., 432 tons of C 24-in., 817 tons of B 30 in.; 60 tons of specials. E. M. Bigelow, Chief of Department of Public Works, Pittsburg, Pa. March 21.

Stone.—Granite curbing, 8,000 lin. ft.; 6,500 sq. yds. of granite paving blocks, 8 to 12 ins. long, 3½ to 4½ ins. wide, 7 to 8½ ins. deep; also 2,500 yds. not to exceed 3 ins. wide. E. L. Squier, Chairman of Highway Committee, Holyoke, Mass. March 21.

Cement.—About 300 bbls. of Portland cement. Capt. J. C. Mallery, U. S. Lighthouse Engineer, Baltimore, Md., March 22.

Lead and Pipe.—About 60 tons of pig lead for pipe joints; 50 tons of lead pipe; 1,000 lbs. of block tin. John Caulfield, Secretary Board of Water Commissioners, St. Paul, Minn. March 22.

Sewers.—In the La Branch St. district. Geo. R. Bringhurst, City Secretary, Houston, Tex. March 24.

Water-Works.—Complete system. Plans and specifications on file. A. Bondman, Jr., Town Recorder, New Castle, Col. March 24.

Sewer Materials.—Salt glazed clay sewer pipe, 8, 10, 12 and 15 ins.; flag stones; 70 sets of catch basin stones; 25 inlet stones. John A. Coleman, Commissioner of City Works, Providence, R. I. March 25.

Broken Stone.—About 5,000 tons, at Sandy Hook. Lt.-Col. G. L. Gillespie, U. S. Engineer office, New York, N. Y. March 31.

Reservoir.—Additional reservoir. W. S. Franklin, Engineer. The Norwich Water-Works, Norwich, N. Y. March 31.

Supplies.—Stone, sand, pebbles and cement. Capt. F. A. Mahan, U. S. Engineer office, Buffalo, N. Y. April 1.

Brick Walls.—Pressed brick walls, etc. James A. Pearce, Secretary of Washington College, Chestertown, Md. April 5.

MANUFACTURING AND TECHNICAL.

Locomotives.—H. K. Porter & Co., of Pittsburg, Pa., have built a small four wheel engine for a street railway in Colombia. It has a noiseless exhaust.

The Schenectady Locomotive Works, of Schenectady, N. Y., have delivered 2 switch engines to the Houston & Texas Central.

The Baldwin Locomotive Works, of Philadelphia, Pa., are building 50 engines for the Philadelphia & Reading.

The Baltimore & Ohio will probably contract for a number of new engines.

Cars.—The Lafayette Car Works, of Lafayette, Ind., have an order for 1,000 box cars for the Erie.

The Litchfield Car & Machine Co., of Litchfield, Ill., is building 60 refrigerator cars for the Wabash.

The Centropolis Car & Machine Works, of Centropolis, Mo., have an order for summer cars for the Interstate Elevated Ry.

The Peninsular Car Works, of Detroit, Mich., have orders for freight cars for the Union Pacific, the Denver & Rio Grande, the Erie, and the Rock Island.

The South Baltimore Car Works, of Baltimore, Md., are building 200 box cars and 250 coal cars for the Baltimore & Ohio Southwestern.

The Pullman Palace Car Co., of Chicago, Ill., has shipped 5 passenger cars to the Seattle, Lake Shore & Eastern.

The Baltimore & Ohio will probably increase its passenger and freight equipment.

The American Car & Equipment Co., of New York, will build car works at Clifton, N. J.

Brakes.—Among recent orders received by the Westinghouse Air Brake Co., is one for the equipment of 6,750 cars of the Chicago, Burlington & Quincy R. R.

Adjustable Car Body.—Borner's supplemental adjustable car body, recently on exhibition at the Pennsylvania depot, Chicago, is an invention designed to convert gondola and stock cars into box cars when needed. It would enable railway companies to load gondola and stock cars from the East instead of sending them West empty. An experimental car has been in service on the Pennsylvania Co.'s line.

The Southern Construction Co. has been organized at Chattanooga, Tenn. President, Gov. John B Gordon, of Georgia; First Vice-President, Charles A. Brooks, of New York: Second Vice-President, Charles O. Beede, of Lynn, Mass.; General Manager, Colonel Danforth, of New York: Secretary and Treasurer, Roland C. Cook, of Chattanooga. Capital stock, $500,000. New York office at 57 Broadway. The company is organized for the purpose of negotiating securities, placing bonds and building railways, water-works and other public works in the South.

Drawbars.—The American Continuous Drawbar Co., of Aurora, Ind., reports an increasing use of its bar. The Illinois Central is applying it to 500 cars now being built by Wells & French, and also to 350 cars being built in its own shops. The Indianapolis Car Works are applying it to 350 cars now under construction for the Pittsburg & Western, and to 310 cars for the Choteau Coal & Railway Co. Pennock Brothers, of Minerva, are equipping 600 cars for the Pittsburg & Western. The Baltimore & Ohio management have applied it to 390 cars just finished, and the Baltimore & Ohio Southwestern will apply it to 900 cars which are to be built at Litchfield.

Snow Flanger.—The Priest Snow Flanger Co., of West Superior, Wis., has been incorporated by A. F. Priest, W. F. Mattes and J. F. Ware. Capital stock, $200,000. The company will manufacture the Priest flanger which has been in use in the Northwest for two winters.

Electric Headlight.—G. H. Prescott, superintendent of motive power of the Vandalia, is said to have pronounced the electric headlight that they have been testing on two of their engines for three months a perfect success. It throws the light from ½ to ¾ of a mile ahead, far enough to stop a train running 60 miles an hour in time to prevent an accident. Another advantage the light has is that the light is thrown directly in front of the locomotive and does not illuminate to any extent on either side of the track. Twelve of the Vandalia engines will be equipped with this light.

Car Wheels.—The St. Thomas Car Wheel Co., of St Thomas, Ont., has been incorporated to manufacture cast-iron and steel car wheels, iron and steel castings, to operate machine shops, etc. Capital stock, $250,000. The incorporators are P.H. Griffin and John Fleming, of Buffalo, N. Y.; T. F. Griffin and C. Sheedy, of Detroit, Mich., and T. A. Griffin, of Chicago, Ill.

Dredge.—A steam dredge with a daily capacity of 800 to 1,000 cu. yds., is wanted by "Frank," Murray Hill Hotel, New York City.

Pipe Works.—The Standard Pipe & Steel Co., of Cincinnati, O., has been organized by T. T. Gaff, Frank Perin, Clifford Perin, the Perin estate, John P. Herron, of the Third National Bank; Charles H. Kellogg, Jr., Vice-President of the Third National Bank; F. A. Doenke, J. G. Schmidlapp, George Wilshire, Colonel Orr, J. G. Taylor, of Cincinnati; Alexander Gordon, of Hamilton, and others. The officers elected are: Alex. Gordon, President, and Chas. H. Kellogg, Jr., Treasurer. Capital stock, $500,000. It is proposed to construct extensive works equipped in the most thorough manner. The buildings will be very large. The amount of ground to be occupied by these works will be more than 40 acres, and the capacity will be between 300 and 400 tons of finished pipe per day.

Traction Engine.—The Atlas Iron Works, at the Potrero, San Francisco, Cal., are building a traction engine. It is on the plan of those used in the Sierras for drawing wagons loaded with lumber along the country roads. It is intended for use in a harvest field for drawing a harvester or for plowing, and embraces many improvements suggested by Mr. Jardine. The driving wheels have tires 20 ins. wide.

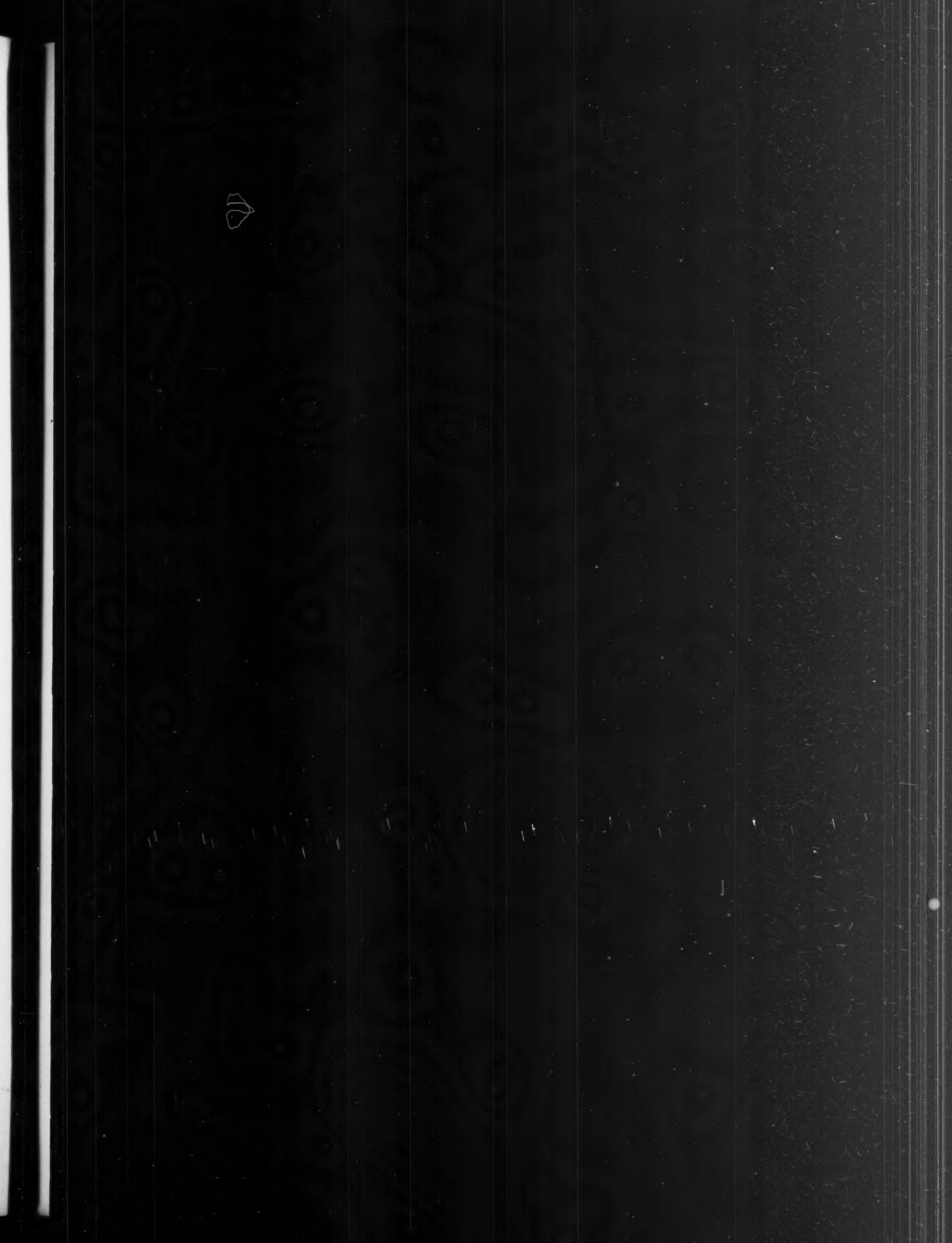
Wind Engines.—The Wind Engine Pump Co. has been organized at Louisville, Ky. President, Thomas Brennan: Vice-President, F. G. Cornell, of Big Rapids, Mich.; Secretary, G. D. C. Ellis. Capital stock, $75 000.

Thos. Carlin's Sons, of Allegheny, Pa., have recently delivered to the Pittsburg & Lake Erie R. R., a double cylinder, 8×10 in., 4 spool bridge building engine; also one of the same size to the U. S. engineer in charge of the new government building in Pittsburg, and a double 6 single drum to Blendinger & Son, of Pittsburg. All of these engines were fitted with the Carlin patent vertical boiler.

Metal Market Prices.—***Rails.***—New York, $34.50 to $35. Chicago: $36.50 to $37.50; old rails, $24 for iron, $21.50 to $22 for steel. Pittsburg: $34 to $35; old rails, $26 for iron, $22.50 to $23 for steel.

Track Materials.—New York: steel and iron angle bars, 2.10 to 2.15 cts.; spikes, 2.15 to 2.25 cts.; track bolts, 3.10 with square and 3.20 to 3.25 cts. with hexagon nuts. Pittsburg: splice bars, 2 cts.; spikes, 2.15 or 2.25 cts. delivered at Chicago or St. Louis; track bolts, 2.90 to 3 cts. with square and 3 to 3.10 cts. with hexagon nuts. Chicago: splice bars, 2 cts for steel and 1.85 cts. for iron; spikes, 2.25 cts.; track bolts, 2.80 to 2.85 cts. with square, and 2.95 to 3 cts. with hexagon nuts.

Pipe.—Cast iron, about $27 to $30 per ton, according to competition and amount of order. Wrought iron, discounts as follows: 47½ and 40 per cent. on black and galvanized butt-welded, 60 and 47½ on black and galvanized lap-welded. Casing, 50 per cent. discount.

Lead.—New York, 3.95 to 3.97½ cts.; Chicago, 3.85 to 3.90 cts.; St. Louis, 3.80 to 3.85 cts.

Structural Material.—Chicago: iron or steel angles, 2.45 to 2.55 cts.; universal plates, 2.50 cts. for iron; 2.55 cts. for steel up to 16 ins. wide, 2.70 for wider steel; steel sheared plates, 2.80 cts.; beams and channels, 3.20 cts. Pittsburg: angles, 2.30 cts.; tees, 2.75 cts.; channels, 3.10 cts.; sheared bridge plates, 2.80 cts.; universal mill plates, 2.45 cts. New York: universal mill plates, 2.20 to 2.25 cts.; angles, 2.20 to 2.30 cts.; tees, 2.60 to 2.70 cts.; beams and channels, 3.10 cts.